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# *MAINTAINABILITY TIME STANDARDS FOR ELECTRONIC EQUIPMENT*

**Boeing Commercial Airplane Company**

John Rose, John J. Voytko and Jesse A. Davolt

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## ROME AIR DEVELOPMENT CENTER
### Air Force Systems Command
### Griffiss Air Force Base, NY 13441

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Data have been developed to enable predictions to be made of the time taken for the maintenance of electronic equipment. The data provided are universal and can be used for any type of electronic equipment and for any conditions that are representative of actual operating maintenance environments.

All standards are derived from General Purpose Data, a system of elemental time standards for simple sequences of body motions. Four "K" factors have been provided to enable synthesized task times to be related to actual times. The "K" factors account for personal, fatigue, and delay allowances, for learning, for skill, and for the error between actual and predicted time (or variability). The contractor's experience with the application of a similar set of elemental standard times for mechanical system maintenance resulted in a high degree of consistency and accuracy.

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Examples of testing and maintenance of an F-15 UHF set have been provided as a demonstration of the type of analysis that can be made with predetermined time standards at any stage of design, manufacture, or use.

# SUMMARY

The objective for the work undertaken was to provide maintenance time standards for use in electronic equipment maintainability predictions. The standards developed provide the means of predicting times that are representative of different environments associated with maintenance of shipboard, ground, and airborne electronic equipment. Data provided include current state-of-the-art electronics such as surface mounted devices and therefore update data in MIL-HDBK-472, which cover tube technology.

The method used to develop the time standards was to synthesize them from General Purpose Data. General Purpose Data is a system of time standards previously used by both Air Force and Navy for predicting times for basic body motions. The standards can be used in conjunction with drawings or manuals and provide all the information necessary for making a prediction or establishing a work measurement standard satisfying MIL-STD-1567A. A stopwatch or field data are not required.

Study "K" factors have been provided to enable synthesized standard times to be related to field operational environments. The "K" factors account for the personal needs of the electronics technician, his working environment, unavoidable interruption, his skill, and his learning capabilities. A "K" factor is also included for prediction error (variability). While no values are currently available for the prediction error for electronics, the prediction error is expected to be small, based on previous experience with mechanical system time standards.

Approximately 100 data sheets have been provided covering electronic repair operations and other operations required to access, remove, and replace electronic equipment. A mnemonic coding system has been developed to aid the maintenance analyst in locating appropriate time standards. Illustrations have been used to show the type of components or tools being addressed by the time standards.

Several examples of the application of standards to predicting times for organizational, intermediate, and depot level repair are provided in the appendix. The examples are for test and repair of an F-15 UHF set and for test of an AGM86 missile. From the examples it can be concluded that all the time standards needed for analysis of electronic equipment testing and repair have been provided. However, four items are recommended for future work:

o Development of a classification and coding system for completed analyses similar to those in the appendix. A coding system will facilitate storage and retrieval for a DOD library of equipment-level time standards.

o Improvement of prediction accuracy by measurement of learning and skill level in a maintenance environment.

o Measurement of maintenance performance under abnormal conditions such as battle conditions and weightlessness.

o Establishment of a data bank of failure rates, by mode of failure, to facilitate the inclusion of fault isolation in mean time to repair analysis.

The contractor believes that, with training and practice, the developed standard times can be used to predict maintenance and fault isolation times for electronic equipment with an accuracy that satisfies the requirement for Type 1 standards of MIL-STD-1567 (Reference 1-1).

## PREFACE

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The expressed or implied use of commercial products or names of manufacturers in this report does not constitute official endorsement of such products or manufacturers by the Air Force or by the contractor.

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3

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

## 1.0: INDEX OF STANDARDS - ELECTRONIC

| | |
|---|---|
| PULL PCB | ETL-PC-R1 |
| CLIP-ON HEAT SINK | ETL-PO-XX |
| PROBE TEST POINT | ETL-TA-XX |
| DESOLDER, BRAID | ETP-DS-R1 |
| DESOLDER, PUMP | ETP-DS-R2 |
| DESOLDER, BULB | ETP-DS-R3 |
| DESOLDER, VACUUM | ETP-DS-R4 |
| TIN WIRE | ETP-SE-X1 |
| SOLDER OR UNSOLDER WIRE | ETP-SE-X2 |
| SOLDER DIP | ETP-SE-X3 |
| SOLDER SLEEVE OF SHIELDED WIRE | ETP-SE-X4 |
| SMD, SOLDERED LEADLESS CHIP CARRIER | ETP-SE-X5 |
| CHANGE BIT OR SLEEVE, WIRE WRAP TOOL | ETP-WW-D1 |
| BUNDLE, LACE | EWH-BL-XX |
| BUNDLE, TIE | EWH-BT-XX |
| CABLE TIE | EWH-CT-XX |
| INSULATION, HEAT-STRIPPING | EWH-IH-XX |
| INSULATION, STRIP | EWH-IS-XX |
| PIN, INSTALL ON WIRE | EWH-PN-I1 |
| PIN, INSTALL OR REMOVE IN PLUG | EWH-PN-I2 |
| WIRE CRIMP, MANUAL TOOLS | EWH-WC-XX |
| WIRE WRAP, HAND TWISTED | EWH-WW-R1 |
| WIRE WRAP, HAND-SQUEEZE GUN | EWH-WW-R2 |
| WIRE WRAP, POWER GUN | EWH-WW-R3 |

CONTROL, MANUALLY ACTUATED .......................... OAC-CM-XX

BUTTERFLY LATCH, UNFASTEN, FASTEN .................... OAC-LP-XX

CLIMB OR DESCEND .................................... OBM-CD-XX

WALK, OBSTRUCTED OR UNOBSTRUCTED .................... OBM-WO-01

HAND CLEAN, SIMPLE SHAPE TO 10-FT$^2$ OBJECT ......... OCL-HS-XX

HOLDING CLAMP, TEMPORARY ............................ OCP-HT-XX

ESTIMATED MANUAL TIME .............................. OEL-ET-XX

OTHER DATA ......................................... OEL-OD-XX

REPEAT SEQUENCE .................................... OEL-RS-XX

TIME STUDY ......................................... OEL-TS-XX

EXAMINE, VISUAL .................................... OIT-EV-XX

HINGED PANEL WITH HOLD-OPEN ROD .................... OJP-AC-XX

CORD, ELECTRIC, COIL AND UNCOIL .................... OJP-CC-XX

PROTECTIVE CAP ..................................... OJP-CF-XX

CLOCK IN, MANUALLY ACTUATED TIME RECORDER .......... OJP-CL-XX

CORD, ELECTRIC, PLUG IN AND DISCONNECT ............. OJP-CP-XX

DRAWER, OPEN AND CLOSE ............................. OJP-DR-XX

ROPE OR CORD, FASTEN OR UNFASTEN ................... OJP-FT-XX

GLASSES OR GOGGLES, SAFETY, ON AND OFF ............. OJP-GS-XX

DRILL BIT, INSTALL ................................. OJP-MA-01

PREPARE MICROSCOPE OR MAGNIFIER .................... OJP-MY-DX

ENSEMBLE, CHEMICAL DEFENSE ......................... OJP-PA-X1

SAFETY HARNESS ..................................... OJP-SA-X1

GET AND ASIDE ...................................... OMH-LA-XX

OBTAIN OR RETURN FILED MATERIAL .................... OMH-OF-XX

OBTAIN OR RETURN PART OR MATERIAL .................. OMH-OP-XX

FASTENER, TURNLOCK ................................. ONF-FT-XX

PRESSURE LATCH, FASTEN OR UNFASTEN ................. ONF-LP-XX

RING, TRU-ARC ...................................... ONF-RT-XX

SAFETY WIRE, CONTINUOUS, NONTWISTED ................ ONF-SC-XX

SNAP RING .......................................... ONF-SR-XX

SAFETY WIRE, TWISTED ............................... ONF-ST-XX

## 1.0: INDEX OF STANDARDS (CONTINUED) - OTHER THAN ELECTRONIC

| | |
|---|---|
| OBJECT HANDLING | OOH-OB-XX |
| DISENGAGE | OOH-DE-XX |
| POSITION OBJECT | OOH-PO-XX |
| TAG, ROUTING, REMOVE OR FILL OUT AND ATTACH | OOH-TR-XX |
| CAN, SCREW CAP, OPEN AND CLOSE | OPK-CS-XX |
| ENVELOPE, OPEN AND REMOVE CONTENTS | OPK-EO-XX |
| OBJECT, UNPACK OR PACK | OPK-OB-XX |
| ESTIMATED PROCESS TIME | OPT-ET-XX |
| TECHNICAL MANUAL, PROCESS ALLOWANCES | OPT-TM-XX |
| READ TECH DATA | ORD-TM-XX |
| COAT, AEROSOL SPRAY | OST-CA-XX |
| BOLT, SCREW, OR NUT, FINGER TIGHT | OTF-BF-XX |
| BOLT, SCREW, OR NUT, NC OR NF, MANUAL TOOLS | OTF-BM-XX |
| BOLT, POWER TOOL | OTF-BP-XX |
| CAP OR PLUG, THREADED, FINGER TIGHT | OTF-CF-XX |
| CAMLOC HIGH-STRESS PANEL FASTENERS | OTF-CH-XX |
| SCREW, MACHINE, MANUAL TOOLS | OTF-SM-XX |
| SCREW, MACHINE, POWER TOOLS | OTF-SP-XX |
| PLIERS, DIAGONAL, SIDE OR END CUTTING | OTL-PD-XX |
| VISE, MECHANICS, POSITION OBJECT AND REMOVE | OTL-VA-XX |
| WRENCH, TORQUE | OTL-WT-XX |
| NUMERIC DATA, TRANSFER | OWR-NT-XX |
| PROSE DATA, TRANSFER | OWR-PT-XX |

# 2.0 GLOSSARY, ACRONYMS, AND ABBREVIATIONS

Elapsed Time:  1) The actual time taken by a worker to complete a task, an operation, or an element of an operation.  2) The total time interval from the beginning to the end of a study.

Elemental Standard Data (ESD):  Elements of work that can be traced to scientifically timed operations and that are intended for synthesis into higher level, more complex operations.

General Purpose Data (GPD):  Data developed from Method Time Measurement (MTM) elements using the building block concept to assemble simple body motion into sequences of several motions.

Idle Time:  Time during which a worker is not working.

Labor Hour:  A unit of measure representing one person working for one hour.  The combination of "n" people working for "h" hours produces "nh" labor hours.  Frequent qualifications to the definition include:  1) designation of work effort as normal effort; 2) designation of time spent as actual clock hours.

Method Time Measurement (MTM):  A procedure that analyzes any manual operation or method into the basic motions required to perform it and assigns to each motion a predetermined time standard determined by the nature of the motion and the conditions under which it is made.

Normal Time:  The time for a qualified worker, working at a pace that can be sustained, to complete a specified operation or sequence of operations.

Personal, Fatigue, and Delay (PF&D):  An allowance over and above normal time to allow a worker to compensate for attending to personal needs, for fatigue, and for delays occurring due to conditions beyond his control.

12

Prediction Error: The difference between an observed time and a normal time multiplied by appropriate "K" factors for PF&D, skill, and learning. Also known as variability.

Time Standard or Standard Time: The time for a qualified worker, working at a pace that can be sustained, to complete a specified operation or operations with allowances for personal comfort, fatigue, and work interruptions.

Time Measurement Unit (TMU): One hundred-thousandth of an hour, 0.00001 hour. (27.8 TMUs = 1 second, 1667 TMUs = 1 minute).

Variability: See prediction error.

| | |
|---|---|
| ANSI | American National Standards Institute |
| APL | Airplane |
| DHU | Decimal Hour Unit (one ten-thousandth of an hour) |
| DIP | Dual Inline Package |
| DOD | Department of Defense |
| E | Electrical and Electronic (time standards) |
| GPD | General Purpose Data |
| GSE | Ground Support Equipment |
| LRU | Line Replaceable Unit |
| MTM | Method Time Measurement |
| NALC | Naval Air Logistics Center |
| NC | National Coarse (screw thread) |
| NF | National Fine (screw thread) |
| O | Other (time standards) |
| OCC | Occurrence |
| PCB | Printed Circuit Board |
| PDTS | Predetermined Time Standards |
| PF&D | Personal, Fatigue, and Delay |
| QTY | Quantity |
| RADC | Rome Air Development Center |
| SMD | Surface Mounted Devices |
| TDR | Time Domain Reflectometer |
| TMU | Time Measurement Unit (one hundred-thousandth of an hour) |
| UHF | Ultrahigh Frequency |

# 3.0 INTRODUCTION

This section of the document provides a guide to understanding the development, scope, and limitations of the standards provided in Section 7.0.

## 3.1 Background

Maintainability prediction is one of the critical activities in equipment design and development. It impacts the definition and attainment of mission requirements. It also impacts life cycle costs. Past investigations and feedback to RADC indicated that current maintainability predictions were indirect, complex in application, only marginally accurate, and were not directly taking into account system engineering design characteristics. Further, techniques for maintainability modeling and trade-offs were virtually nonexistent. Therefore, RADC developed prediction techniques under Contract No. F30602-76-C-0242 that are based on a time synthesis model. The techniques are documented in a report entitled "Maintainability Prediction and Analysis Study", report RADC-TR-78-169, Reference 3-1. A subsequent data validation study under Contract F-30602-81-C-0081 (Reference 3-2) showed that the maintenance time standards contained in RADC-TR-78-169 were: 1) indicative of conditions resulting from repetitive performance of tasks and, 2) not characteristic of the maintenance environments associated with military systems.

As well as remedying the above criticisms, the objective for the time standards presented in this document is to use them as a basis for updating data for maintenance task time analysis presented in MIL-HDBK-472.

MIL-HDBK-472 provides four methods of predicting the maintenance times for electronic equipment, and Procedure II of MIL-HDBK-472 is also based on a time synthesis model. However, the tables in the handbook are based on old state-of-the-art components and are inadequate for present-day design analysis. Tables 3.1-1 and 3.1-2 show the type of components currently covered by MIL-HDBK-472.

TABLE 3.1-1: INTERCHANGE TIMES (FROM MIL-HDBK-472, TABLE 2-3)

| PART TYPE | AVERAGE TIME (HOURS) |
|---|---|
| Plug-in tubes | 0.015 |
| Wired tubes (4 wires) | 0.149 |
| Wired tubes (more than 4 wires) | 0.149 + 0.034 per wire over 4 |
| All tubes    with shield<br>          with clamp<br>          with cap | ADD  0.007<br>ADD  0.027<br>ADD  0.007 |
| Plug-in fuses | 0.010 |
| Screw-in fuses | 0.015 |
| All fuses with screw cap | 0.014 |

| PARTS OTHER THAN TUBES AND FUSES | |
|---|---|
| PART TYPE | AVERAGE TIME (HOURS) |
| Parts with 2 wires or 2 tabs to be soldered | 0.081 |
| Parts with more than 2 wires or 2 tabs to be soldered<br>         with clamp | 0.081 + 0.034 per wire over 2<br>ADD  0.027 |
| Parts attached with screws, nuts, and washers | ADD  0.022 for each screw, nut and washer combination |

## TABLE 3.1-2: ELEMENT TIMES BASED ON THE WORK FACTOR SYSTEM
### (FROM MIL-HDBK-472, TABLE 2-4)

| ELEMENT DESCRIPTION | ELEMENT TIME* (Hours) |
|---|---|
| 1. PLUG-INS (including handling) | |
| Pin-type tubes, plug-in parts, etc. | 0.0075 |
| Tub cap or shield | 0.0035 |
| Fuse | |
| Insert into horizontal holder | 0.0050 |
| Insert into vertical holder | 0.0075 |
| 2. WIRING AND SOLDERING | |
| Wire wrapping and splicing | |
| Bare copper wire (1) End | 0.0150 |
| (2) Ends | 0.0237 |
| Jumper wire and cable leads (1) End | 0.0134 |
| (2) Ends | 0.0265 |
| Part with axial leads (includes part handling) | |
| (1) End | 0.0178 |
| (2) Ends | 0.0289 |
| Solder | |
| Per joint | 0.0058 |
| 3. REPLACEMENT WITH HARDWARE | |
| Replace screw into tapped hole | 0.0093 |
| Replace screw through clearance hole | 0.0023 |
| Replace washer | 0.0018 |
| Replace nut | 0.0071 |
| Replace stop nut | 0.0210 |
| Replace set screw | 0.0075 |
| Apply glyptol screw | 0.0018 |
| 4. PART HANDLING | |
| Pull up part and position in chassis for assembly | 0.0025 |
| 5. PRINTED CIRCUIT WIRING | |
| Replace (insert) | 0.0033/End |
| Solder | 0.0056/End |

\* The interchange task aboard ship does not involve the repetitive (cyclic) factory type of regularly occurring motions; therefore, those interchange element times are based on noncyclic and irregularly occurring motions.

However, irrespective of the need to update MIL-HDBK-472, the primary objective is to provide time standards for use in synthesis of maintenance times for contemporary electronic equipment, using the application method developed in RADC-TR-78-169. The standards are representative of the nonrepetitive nature of maintenance and the environments in which it is accomplished.

## 3.2 Approach and Rationale

Since the contractor had previously developed time standards for maintenance of mechanical systems based on the use of Predetermined Time Standards (PDTS) (defined in Reference 3-3 and described in Reference 3-4), the same approach appeared logical for electronic equipment maintenance. The PDTS system known as Method Time Measurement (MTM) forms the foundation of the standards developed for this document. MTM is probably the most widely used time standards system used for industrial applications and consists of several sets of data that are based on 11 basic body motions:

| | |
|---|---|
| Reach | Disengage |
| Move | Eye Travel and Focus |
| Turn | Body, Leg, and Foot Motion |
| Apply Pressure | Position |
| Grasp | Release |
| Crank | |

The historical development, verification, and validation of the times associated with the basic body motions of MTM are described in Chapter 4 of Engineered Work Measurement, Reference 3-5. The standard motions can obviously be combined into more complex sets of motions. For instance, the pick up and position of a part might consist of a reach, grasp, move part, regrasp, position, and release. The simple body motions of MTM can thus be used to form more complex operations, and a system of standards known as General Purpose Data (GPD) has evolved from Method Time Measurement. In practice, the application of standards based on fundamental body motions,

18

even at a GPD level, is a time-consuming process. Higher level, more complex standards have therefore been developed that retain most of the accuracy of the fundamental General Purpose Data standards from which they are derived. A simple example of the way in which the high level standards of this document have been developed from GPD is the installation of a protective plastic cap on the end of a cable. The operation consists of the following body motions:

o  Get the cap.
o  Get the part to be capped.
o  Position the cap.
o  Apply pressure to the cap.

The motions correspond to GPD elements for:

o  A "get" of a jumbled object with one hand with a reach of 18 inches.
o  A "get" of an easily grasped object at a variable location with a reach of three to nine inches.
o  A symmetrical "place" of a closely fitting object at a distance of 18 inches.
o  An "apply pressure" case 1.  (Case 1 requires orientation or adjustment to avoid loss of grip during application of force).

Since standard times exist for each of the above GPD elements, the time for installing a protective cap can be readily derived and is 96 Time Measurement Units (TMU).

The removal time can be developed in a similar manner and becomes the standard shown in Figure 3.2-1.

|        | REMOVE |     | INSTALL |     |
|--------|--------|-----|---------|-----|
|        | FIRST  | TMU | FIRST   | TMU |
|        | R1     | 90  | I1      | 96  |

**Remove**

Begins with getting capped part.  Includes reaching to cap, applying pressure
to cap, disengaging cap.  Ends with asiding cap.

**Install**

Begins with getting protective cap.  Includes getting part to be capped,
positioning cap.  Ends with applying pressure to complete cap installation.

Figure 3.2-1:  A Typical Time Standard

If it were necessary to use a tool to remove the protective cap then the
"first" removal would include the body motions to get the tool at the start
of the operation and aside it at the end of the operation.  An "additional"
operation time would have been developed that excluded the get and aside of
the tool.  A number of standards with "first" and "additional" operations
will be seen in Section 7.0.

Higher level elemental standards such as those of Figure 3.2-1 can still be
used in many different combinations as may be seen from the examples
provided in Appendix A.  The examples would have consisted of many
thousands of body motions at a GPD level.

An alternative to a system of synthesized elemental standards would have
been to observe and time actual maintenance operations.  There are several
problems with this procedure.  First, there must be a sufficiently large
number of repetitions of the operations to determine an estimate of the
mean time with a specified confidence.  Second, there is a variation in
time taken from one technician to another.  Recorded times must therefore
be leveled to those of an average technician.  Finally, observation and
timing can not be used for design review and critique because at that early
date the equipment does not yet physically exist.

Wherever possible, use was made of existing elemental standards, mostly from DOD 5010.15.1-M, Volume VII (Reference 3-6). Where existing standards have been used, they have been checked for accuracy and suitability as electronics maintenance standards and reformatted for compatability with the new standards developed. A prerequisite for including a standard in this document is that it can be traced back to a General Purpose Data source, thus ensuring the consistency of all standards provided.

## 3.3 Training

MTM data on which the standards in this document are ultimately based carries with it the following warning from the MTM Association:

> Do not attempt to apply Methods Time
> Measurement in any wa unless you under-
> stand the proper appliation of the data.
> This statement is included as a word of
> caution to prevent difficulties resulting
> from misapplication of the data.

The same caution applies to the application of standard data provided in Section 7.0. The development of a maintenance task time analysis involves a number of analytical skills. The analyst must be capable of defining, in detail, the elements of the work to be performed by a mechanic or technician. Typical task descriptions are shown in Appendix A. For the development of fault isolation times, the analyst must also have the ability to determine the failure modes, their effects on the system, subsystem, and failed component, and the failure rate associated with each mode. Examples of fault isolation analyses are also provided in Appendix A.

The knowledge necessary for time standard data application can be obtained by taking one or more of the courses detailed in DOD 5010.15.1-M (Appendix III Basic Volume, Reference 3-7). The purpose of training is to ensure that standards are uniformly applied and can be used with confidence.

# 4.0 THE STANDARD DATA APPLICATION METHOD

The process of making a maintenance analysis consists of five steps and assumes that the analyst is thoroughly familiar with the elemental standards available.

The first step is to match the maintenance work to be performed with the work description for first and additional operations from the standard. This step is explained in Section 4.1.

The second step is to establish the case difficulty (Section 4.2).

The third step is to determine the number of times an operation is repeated, as well as the probability of occurrence, and the number of people involved (Section 4.3).

The fourth step is to perform the simple calculations necessary to determine elapsed time and labor hours.

The final step is to apply "K" factors to cover personal, fatigue, and delay allowances, and if appropriate, skill, learning, and error factors.

Appendix A provides a series of examples showing the application of time standards to the analysis of organizational, intermediate, and depot level maintenance of electronic equipment. Application format is shown in Figure 4.0-1.

| (1) | (2) | (3) | (4) | (5) | (6) | | (7) | (8) | |
|---|---|---|---|---|---|---|---|---|---|
| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | DHU ELAPSED | TOTAL |
| 02 | RMV & INSTL MODULE, POWER SUPPLY 1A8 | | | | | | | 1161 | 1161 |
| A | RMV MODULE AND COVER | | | | | | 100 | 536 | 536 |
| 1 | LOOSEN MODULE HOLD DOWN SCREWS (EQ TO) | | | OTL-WT-02 | 1 | 3 | | 108 | |
| 2 | RMV COVER RETAINING SCREWS | | | OTF-SM-RB | 1 | 4 | | 428 | |
| B | INSTL COVER & MODULE | | | | | | 100 | 625 | 625 |
| 1 | POSN COVER | | | OOH-PO-CB | 1 | | | 25 | |
| 2 | INSTL COVER RETAINING SCREWS | | | OTF-SM-IB | 1 | 4 | | 450 | |
| 3 | POSN MODULE | | | OOH-PO-OC | 1 | | | 42 | |
| 4 | TIGHTEN MODULE HOLD DOWN SCREWS (EQ TO) | | | OTL-WT-02 | 1 | 3 | | 108 | |

Figure 4.0-1: Example of Data Application Format

The example format consists of eight columns identified in Figure 4.0-1 by numbers (1) through (8).

(1)  The STEP column provides a number reference for the overall task, a letter reference for the suboperation, and a number for each element of the suboperation.

(2)  A DESCRIPTION is provided for the task, suboperation, and element.

(3)  Where more than one worker is required, each is identified by WORKER I/O.

(4)  Work that is simultaneous is cross-referenced under SIMO by the STEP designator from column (1).

(5)  Elemental standards are referenced in the column headed CODE.  The coding system is explained in Section 7.1.

(6)  The quantity of first and additional work elements is entered in column (6).  (First elements include time to get and aside objects that are then available for additional elements.)

(7)  The use of OCC (occurrencing factors) is explained in Section 4.3. They are entered as a percentage.

(8)  For each element, the first and additional times that correspond to the element referenced in column (5) are multiplied by QTY, column (6), and summed to arrive at the elasped time, column (8), then multipl.ed by OCC, column (7), to give the total time, column (8).

In the Data Applications of Appendix A, time units are in Decimal Hour Units (DHU), which equal ten Time Measurement Units (TMU):

$$100,000 \text{ TMU} = 1 \text{ hour}$$
$$10,000 \text{ DHU} = 1 \text{ hour}$$
$$1 \text{ DHU} = .0001 \text{ hour}$$
$$2.78 \text{ DHU} = 1 \text{ second}$$
$$166.7 \text{ DHU} = 1 \text{ minute}$$

Suboperation summaries and task summaries are also provided with each of the tasks analyzed in Appendix A. A typical summary shown in Figure 4.0-2.

```
                        TASK CODE: 152314XM01
                                   ===========

                        PART NAME: UHF RADIO SYSTEM
SUMMARY
-------

APL MODEL: F-15        PART NO:                       ZONE:

TASK DESCRIPTION:  *    CONDUCT FLT LINE TEST TO
                   *    ISOLATE TROUBLES IN UHF RADIO
                   *    SYSTEM




PREPARED BY:  J.DAVOLT       ORG: B7463     DATE: 1-9-84P

REQUESTED BY: J.ROSE         ORG: B7463     REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:      THIS   ANALYSIS   IS  FOR  USE  AS  AN  EXAMPLE  OF
              MAINTAINABILITY   TIME   STANDARDS   APPLICATION. THE
              UHF  RADIO AN/AR109 IS INSTALLED ON F-15 AIRCRAFT.
              USING  THE  TEST  SET  AN/ARM-113  AT  THE  APL  IS
              OPTIONAL  TO  REMOVING THE TRANSCEIVER, CONTROLLER
              OR  INTERCOM  SET  AND  PERFORMING  THE TESTS ON A
              BENCH SETUP. IN THIS ANALYSIS IT IS ASSUMED ACCESS
              TO  THE  UHF  SET  IS  OPEN AND A WORK PLATFORM IS
              POSITIONED  PER 112314XM01. ASSUME THE APL IS IN A
              HANGAR. POWER IS CONNECTED TO APL.

--------------------- TASK TIME SUMMARY ----------------------


    TOTAL MANHOURS:    .93 HRS ...... WITH PF&D:   1.11 HRS

    TOTAL ELAPSED:     .46 HRS ...... WITH PF&D:    .56 HRS


    OSE REQUIRED:   YES               PERSONAL:    9%

                                      FATIGUE:     6%

                                      DELAY:       5%
```

Figure 4.0-2:  Example of an Application Summary

The total labor hours and total elapsed times without and with PF&D are provided with the summary. In addition, the labor hours and elapsed times without and with PF&D are shown for work at the airplane (APL). Work at the airplane excludes the primary job preparation and termination so that several jobs on the aircraft can be readily combined.

## 4.1 Selecting Standards

Standards are selected by breaking down the overall task into more and more detailed elements until a match with the standard job descriptions of Section 7.0 is found. A prerequisite is that the analyst is familiar with all available standards. For instance, removing a black box from an airplane can be broken down into:

1) Walking to the airplane
2) Checking that the power is off
3) Opening an access door
4) Disconnecting the cables
5) Loosening the equipment hold-downs
6) Disengaging the equipment from the airplane

Once the task has been broken into a number of suboperations, a search is made for existing predetermined times. For example, element 6 above, matches data element OOH-DE in Section 7.0, also shown in Figure 4.1-1.

OOH-DE-XX                                                          DISENGAGE

---

| DISENGAGE | TMU |
|-----------|-----|
| OA | 70 |
| OB | 120 |
| OC | 220 |
| OD | 400 |
| OE | 700 |

**Disengage**

Begins with reaching to object or tool. Includes obtaining control of object with hand(s), or with tool when tool is an extension of the hand(s), and loosening and extracting or removing one object from another. Ends with laying aside tool and/or object.

**Remarks**

Tools included are a putty knife, screw driver, pliers, or similar to overcome the limitations of hand or finger dexterity or access. Strength may be used with slight to considerable effort. Use of hammer is not included.

Case variable factors: distance 45%, weight 10%, control 45%.

Figure 4.1-1:  Standard Times for Disengaging

Having matched the work and the standard, the analyst must next select the level of difficulty for the work. In the case of DISENGAGE, Figure 4.1-1, five levels are available from Very Easy (A) to Very Difficult (E). A typical example is also shown in Figure 4.1-2 for a standard that can be used for releasing door latches.

FASTENER, TURNLOCK TO 3/8-in. DIA                                       ONF-FT-XX

|          | FIRST | TMU | ADDITIONAL | TMU |
|----------|-------|-----|------------|-----|
| Unfasten | RA    | 110 | YA         | 60  |
| Unfasten | RB    | 160 | YB         | 80  |
| Fasten   | IA    | 140 | XA         | 90  |
| Fasten   | IB    | 200 | XB         | 130 |

**Unfasten First Piece**

Begins with reaching to tool. Includes positioning tool to fastener stud and twisting to unfasten stud from receptacle. Ends with laying aside tool.

**Unfasten Additional Piece**

Begins with moving to fastener stud with tool. Includes positioning tool to stud and twisting to unfasten. Ends with unfastening stud from receptacle.

**Fasten First Piece**

Begins with reaching to tool. Includes positioning tool to fastener stud and twisting stud to secure in receptacle. Ends with laying aside tool.

**Fasten Additional Piece**

Begins with moving to fastener stud with tool. Includes positioning tool to stud and twisting to secure. Ends with fastening stud to receptacle.

**Remarks**

Applies to DZUS, CAMLOC, AIRLOCK and similar fasteners.

Case variable factors: distance 10%, weight 5%, control 85%.

Figure 4.1-2: Typical Standard Data Sheet

For ONF-FT only two levels of difficulty are provided, Very Easy (RA, YA) and Easy (RB, YB). Once case difficulty has been selected, the analyst can obtain the corresponding time from the table at the top of the sheet. However, to remove the subjectiveness of selecting case difficulty the procedure of Section 4.2 should be used. Units of time in the standard data sheets are Time Measurement Units or TMUs. (One TMU is equal to .00001 of an hour and there are 27.8 TMUs to a second.)

## 4.2 Case Difficulty

Some of the standard data in Section 7.0 have been developed to provide the analyst with the choice of different levels of difficulty for the operation described.

Table 4.2-1 provides examples of the three case variable percentages by which distance, weight, and control were judged to contribute to the work difficulty.

TABLE 4.2-1:   EXAMPLES OF CASE VARIABLE PERCENTAGES

| Standard | Case Variable Percentage | | |
|----------|--------------------------|--------|---------|
|          | Distance | Weight | Control |
| ENF-CB-XX | 10 | 5 | 85 |
| OMH-LA-XX | 80 | 20 | 0 |
| ONF-FT-XX | 10 | 5 | 85 |
| ONF-SR-XX | 10 | 5 | 85 |

The case variable percentages are provided with each elemental standard data sheet in Section 7.0 to which they apply.   The definitions of case difficulty used in constructing the standards are shown in Table 4.2-2. When applying a standard, Table 4.2-2 can be used to remove some of the subjectiveness in selecting a level of difficulty.   For example, if a two-pound object was moved to an exact location 12 inches away it would be classed as a Very Easy case.   The cases for different distances and degrees of control can be determined in a similar manner.

Having decided on levels of difficulty for distance, weight, and control, a case variable multiplier is obtained from Table 4.2-3.

27

TABLE 4.2-2: LEVEL OF DIFFICULTY DEFINITIONS

| LEVEL | DISTANCE | WEIGHT (LB) | CONTROL - SEE REACH AND MOVE BELOW* |
|-------|----------|-------------|-------------------------------------|
| A<br><br>VERY<br>EASY | WITHIN 18-IN. RADIUS, NO BENDING, STOOPING, OR OTHER BODY ASSISTS. | 0 - 3 | A,B,E REACHES - A,B,C MOVES. ACCOMPLISHMENT IS UNOBSTRUCTED, OBJECT CLEARLY VISIBLE, FIT, IF APPLICABLE, IS LOOSE AND OBJECT IS EASY TO HANDLE. (CLASS "1" POSITIONS). MAXIMUM 1-IN. RECOIL ON DISENGAGE. |
| B<br><br>EASY | SAME AS ABOVE, WITHIN 30-IN. RADIUS AND INCLUDING BODY ASSIST BUT NO BENDING OR STOOPING. | 3 - 10 | C,D REACHES - C MOVES. SOME INTERFERENCE, OBJECT WHOLLY VISIBLE, OR NO INTERFERENCE, OBJECT PARTLY VISIBLE. FIT, IF APPLICABLE, IS LOOSE AND OBJECT IS DIFFICULT TO HANDLE. (CLASS "1" POSITIONS). MAXIMUM 1-IN. RECOIL ON DISENGAGE. |
| C<br><br>MODERATE | SAME AS EASY, BUT WITHIN 4-FT RADIUS AND INCLUDING BENDING AND STOOPING. | 10-25 | C,D REACHES - C MOVES. INTERFERENCE, OBJECT PARTIALLY VISIBLE. FIT, IF APPLICABLE, IS CLOSE, (CLASS "2" POSITIONS). MAXIMUM 5-IN. RECOIL ON DISENGAGE. |
| D<br><br>DIFFICULT | SAME AS MODERATE, BUT WITHIN A 6-FT RADIUS. | 25-50 | C,D REACHES - C MOVES. INTERFERENCE, OBJECT IS NOT VISIBLE OR INTERFERENCE AND PARTIALLY VISIBLE. FIT, IF APPLICABLE, IS EXACT. (CLASS "3" POSITIONS). OVER 5-IN. RECOIL ON DISENGAGE. |
| E<br><br>VERY<br>DIFFICULT | SAME AS DIFFICULT BUT WITHIN AN 8-FT RADIUS. | OVER 50 | C,D REACHES - C MOVES. OBSTRUCTED AND NOT VISIBLE. FIT, IF APPLICABLE, IS EXACT, ACCOMPLISHMENT BY MULTIPLE AND/OR NON-SYMMETRICAL, DIFFICULT POSITIONS. OVER 5-IN. RECOIL ON DISENGAGE. |

* <u>MTM REACH</u>

    A - TO OBJECT IN FIXED LOCATION OR TO OTHER HAND
    B - TO OBJECT IN LOCATION WHICH VARIES SLIGHTLY
    E - TO INDEFINITE LOCATION OR A REACH TO BALANCE THE BODY
    C - TO JUMBLED OBJECTS REQUIRING SEARCH AND SELECT
    D - TO A SMALL OBJECT REQUIRING AN ACCURATE GRASP

* <u>MTM MOVES</u>

    A - MOVE OBJECT TO OTHER HAND OR AGAINST STOP
    B - TO AN APPROXIMATE OR INDEFINITE LOCATION
    C - TO AN EXACT LOCATION

TABLE 4.2-3:  CASE VARIABLE MULTIPLIERS

| Case | Multiplier M |
|---|---|
| Very Easy | 0.1 |
| Easy | 0.3 |
| Moderate | 0.5 |
| Difficult | 0.7 |
| Very Difficult | 0.9 |

The case variable percentage from Table 4.2-1, or from individual standards in Section 7.0, multiplied by "M" from Table 4.2-3, gives the case variable factor "F".  The final step is to add the case variable factors together and then use Table 4.2-4 to determine the combined case.

TABLE 4.2-4:  COMBINED CASE CODES

| Sum of "F" Factors | Case To Use | Case Code |
|---|---|---|
| 0 - 19.9 | Very Easy | A |
| 20 - 39.9 | Easy | B |
| 40 - 59.9 | Moderate | C |
| 60 - 79.9 | Difficult | D |
| 80 - 100 | Very Difficult | E |

Example

A black box is to be removed from its mounting through a small access panel.  Its fasteners and connectors have been released and removed and now it is to be disengaged and moved 30 inches.  It weighs 40 pounds and is only partially visible.

1)  From Table 4.2-2:

    30 inches distance is an Easy case

    40 pounds weight is a Difficult case

    "Partially visible" is a Moderate case

29

2) For Disengage OOH-DE-XX (Figure 4.1-1)
   the case variable factors are:
   Distance 45%
   Weight 10%
   Control 45%

3) Using the individual difficulties from (1) above in Table 4.2-3,
   case variable multipliers are:
   Distance, Easy          0.3
   Weight, Difficult       0.7
   Control, Moderate       0.5

4) Percentages (2) are multiplied by the results of (3) and added:

   | Individual Case | % | x | M | = | F |
   |---|---|---|---|---|---|
   | Distance | 45 | x | 0.3 | = | 13.5 |
   | Weight | 10 | x | 0.7 | = | 7.0 |
   | Control | 45 | x | 0.5 | = | 22.5 |
   | | | | | Total = | 43 |

5) From Table 4.2-4, the combined case for a sum of F values of 43 is
   Moderate (40-59.9).

6) The disengage operation for the black box is given the code OOH-DE-OC
   in accordance with the details of the coding system provided in Section
   7.1, OC being used for Moderate.  A time value of 220 TMUs (or eight
   seconds) is now obtained from Figure 4.1-1 for a Moderate case with a
   code "OC".

30

## 4.3 Occurrencing

An occurrence factor has two uses. The first, and simpler, of the two uses is to represent the relative frequency with which an operation takes place. For example, if once in every three soldering operations the solder is regrasped, then the time for regrasping would be given an occurrence factor of 33%. This technique is usable in both the development and application of elemental standard data.

The second and more complex use of occurrencing is to account for both the labor hours and elapsed time for tasks involving more than one person. For example, imagine two mechanics sharing the same operation, such as the removal of four bolts, in which each mechanic requires 3070 TMU, with 6140 TMU for the total task. The reader of an analysis would see 6140 TMU displayed with a 50% occurrence factor, yielding an elapsed time of 3070 TMU. Labor hours and elapsed time are both important maintainability parameters and one method of accounting for them is illustrated by Figure 4.3-1.



TASK CODE: 152314XM01

STANDARD DATA APPLICATION                    PART NAME: UHF RADIO SYSTEM

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC | DHU ELAPSED | TOTAL |
|------|-------------|------------|-----------|------|-------------|-----|-------------|-------|
| 01 | CONDUCT FLT LINE TEST TO ISOLATE TROUBLES IN UHF RADIO SYSTEM | 1,2 | | | | | 4627 | 9254 |
| A | JOB PREPARATION | 1,2 | | | | | 200 | 562 | 1124 |
| 1 | OBTAIN TECHNICAL INFORMATION REQUIRED | 1 | 2 | OMM-OF-O1 | 1 | | -20 | |
| 2 | OBTAIN TEST EQUIPMENT AND TOOLS | 2 | 1 | OOH-OB-O1 | 2 | | 96 | |
| 3 | FROM SHOP TO APL | 1,2 | | OBM-HO-O1 | 37 | | 333 | |
| 4 | ASIDE TEST EQUIPMENT AND TOOLS | 1,2 | | OOH-OB-O2 | 2 | | 96 | |
| 5 | UP H/STAND TO ACCESS DOOR | 1 | 6 | OBM-HO-O1 | 1 | | 9 | |
| 6 | TO COCKPIT | 2 | 5 | OBM-HO-O1 | 1 | | -8 | |
| 7 | LOCATE UHF RADIO SW | 2 | | OIT-EV-ZB | | 2 | 20 | |
| 8 | TURN OFF UHF SWITCH | 2 | 9 | OAC-CM-O2 | 1 | | 8 | |
| 9 | TURN OFF TEST SET PWR SW | 1 | 8 | OAC-CM-O2 | 1 | | -7 | |
| B | INSTL TEST EQUIPMENT | 1 | C | | | | 200 | 1096 | 2192 |
| 1 | POSIT TEST EQUIPMENT ADJACENT TO UHF RADIO | 1 | | OOH-OB-O1 | 1 | | 48 | |
| 2 | INSTL TEST CABLE ASSEMBLIES TO HOOK TEST EQUIPT PER FIO 5-1 | 1 | | ETF-CE-IC | 9 | | 765 | |
| 3 | RMV SAFETY WIRE FROM ANTENNA CONNECTOR | 1 | | ONF-ST-RB | 1 | 1 | 122 | |
| 4 | RMV CONNECTOR FROM ANTENNA CONNECTION TO R/T UNIT | 1 | | ETF-CE-RC | 2 | | 142 | |
| 5 | RMV CONNECTOR FROM J4 OF R/T UNIT | 1 | | ENF-CB-RC | 1 | | 19 | |
| C | SET CONDITIONS FOR TEST | 2 | B | | | | 100 | -60 | |
| 1 | SELECT APPROVED TEST FREQUENCY | 2 | | OAC-CM-O2 | | | | |
| 2 | SELECT MANUAL ON MODE SELECTOR | 2 | | | | | | |
| 3 | VOLUME CONTROL TO MAXIMUM | 2 | | | | | | |
| 4 | FUNCTION SWITCH OFF | 2 | | | | | | |
| 5 | TONE AND SQ DISABLE SWITCHES RELEASED | 2 | | | | | | |
| 6 | PRIMARY PWR SWITCH ON | | | | | | | |

Figure 4.3-1:  Task Analysis for Multiple Workers

In Figure 4.3-1 complete suboperations have been occurrenced. In suboperations A and B the elapsed time is factored by 200% to give the labor hours for workers one and two. The convention of a minus sign in the elapsed time column signifies an element, or suboperation, that takes place in parallel with another element or suboperation. Entries with a minus sign are ignored, not subtracted, in accumulating elapsed times. For example, while worker number one is performing suboperation B, for a total of 1096 DHUs, worker number two completes suboperation C in 60 DHUs. Worker number two's labor hours and idle time are accounted for with worker number one by the occurrence factor of 200% in suboperation B. (The analysis of Figure 4.3-1 is part of the series of examples for repair of an F-15 UHF radio provided in Appendix A.)

## 4.4 Use of Personal, Fatigue, and Delay Allowances (PF&D)

Since all the elemental standard data provided in Section 7.0 is based on a continuous series of body motions, it is necessary to add allowances for hygiene and personal comfort needs, for the different factors resulting in fatigue, and for uncontrollable delays and interruptions.

A comprehensive set of PF&D allowances is provided in Reference 3-7, and for convenience, the data are reproduced in Section 5.1. The PF&D allowances are for such things as working position (sitting, standing, walking), physical factors such as moving weights in different positions, heat, lighting, mental concentration, monotony, and so on.

Typical PF&D allowances are:

o Bench or shop work at a normal pace and temperature:
    5% personal
    5% fatigue
    5% delay
o For work below $40^\circ F$ or above $90^\circ F$:
    3% additional fatigue allowance
o Use of heavy protective clothing:
    5% additional fatigue allowance

Work on an airplane under typical conditions is shown in Table 4.4-1.

TABLE 4.4-1:  TYPICAL PF&D FOR WORK ON AN AIRPLANE

| Conditions | | Inside Aircraft | Outside Aircraft |
|---|---|---|---|
| Work Area | Equipment Handling | | |
| Open | Easy | 18% (8-5-5) | 20% (9-6-5) |
| Open | Difficult | 19% (8-6-5) | 21% (9-7-5) |
| Moderate | Easy | 21% (8-8-5) | 23% (9-9-5) |
| Moderate | Difficult | 22% (8-9-5) | 24% (9-10-5) |

## 4.5 Environment

Environment is the term used to describe the conditions that surround the area in which maintenance is performed. Examples of natural environments are moisture, heat, cold, wave motion, rain, wind, snow, ice, sand, and dust. Induced environments include vibration, clean-room conditions, radiation, weightlessness, explosive atmosphere, and noise. Conditions such as rain, snow, and cold entail the use of protective clothing or special equipment such as heaters.

Arctic or foul-weather gear may result in interference or loss of visibility. Such gear increases the degree of control required and the increased degree of control results in higher levels of difficulty as well as higher than normal personal and fatigue allowances. A typical example, such as chemical warfare clothing that includes two layers of gloves, may result in an "easy" job element becoming "moderate" or "difficult". In addition, the outfit is hot, cumbersome, and uncomfortable (Figure 4.5-1).

A full table of fatigue allowances is contained in Section 5.1.
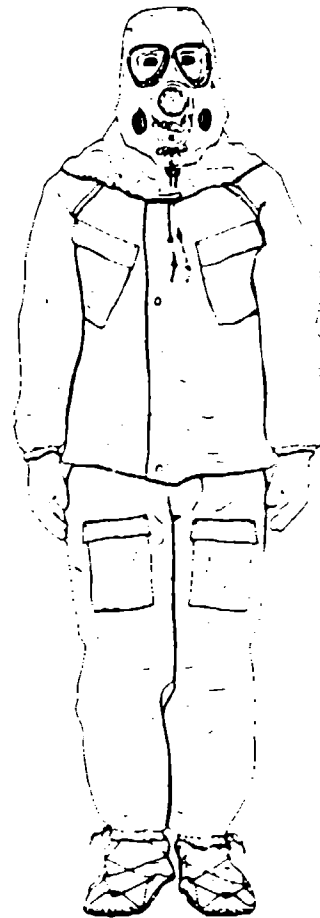
Figure 4.5-1: Groundcrew Chemical Defense Ensemble

34

From the fatigue tables, the percentages by which the normal time might be increased under chemical warfare conditions are:

| Percent | As a Result of |
|---|---|
| 2 | Face shield |
| 2 | Rubber boots |
| 4 | Heavy protective clothing |
| 5 | Filter mask |
| 3 | Heat factor |
| 2 | Standing |
| 8 | Concentration and manual dexterity |
| 1 | Noise |
| 27 | **Total Fatigue Allowance** |

Personal allowance for a chemical warfare environment might consist of:

| Percent | As a Result of |
|---|---|
| 6 | Extremely disagreeable conditions |
| 4.2 | Preparation and cleanup |
| 4.0 | Adjunctive allowance for special clothing |
| 14.2 | **Total Personal Allowance** |

With an allowance of 5% for unavoidable delays, the increase in work time due to PF&D would be 46% (27 + 14 + 5), compared with 15% for bench work under normal conditions. The use of a chemical warfare groundcrew ensemble also causes problems with heat stress. Periodic rest cycles are required and details are provided in Section 5.3.

## 4.6 Shipboard Conditions

As well as the environments provided for by the tables of Section 5.1, the environment for shipboard maintenance has the additional complication of ship's motion. For example, a destroyer commonly rolls 25 degrees from vertical and may occasionally roll 40 degrees or more during which time only vital maintenance is performed. Under such conditions maintenance includes operations such as clamping equipment (OCP-HT-XX), tieing down

tools (OJP-FT-XX), or returning tools and equipment not in use to drawers or cabinets (OMH-OP-XX). Working on superstructure -- an antenna, for example -- involves the use of a safety harness (OJP-SA-X1). In addition, linear and angular accelerations during pitch, roll, and yaw add to and subtract from gravitational acceleration and change the weight of equipment being handled, thereby changing level of difficulty to a more severe case.

## 5.0 ALLOWANCES AND VARIABILITY FACTORS

Section 5.0 provides data to enable an analyst to relate time standards developed using the synthesis technique described in Sections 4.1, 4.2, and 4.3 to the times that are experienced in an actual operational environment. Differences between actual and normal times are accounted for by four "K" factors. The first factor is the Personal, Fatigue, and Delay allowance, used to account for differences in times for the same work performed under different conditions and environments. PF&Ds to cover all environments are provided in Section 5.1. The second factor is for skill, capability, and motivation of individual technicians and a method of accounting for this factor is provided in Section 5.2. The third factor is that associated with how well an average electronics technician has learned to perform a given task or a given type of work. Very little data on the "K" factors for learning are available and the only substantiated data found are provided in Section 5.2. The fourth factor is an error or variability factor that accounts for the difference between the actual time taken and the predicted time.

Normal time, synthesized from the predetermined standards of Section 7.0, is thus related to actual time taken in the field by the expression:

$$AT(t) = N \ ( \ K(PF\&D) + ( \ K(S) \ x \ K(L) \ ) - 1 + K(e))$$

Where:

$AT(t)$ = Actual time after t hours or units of repetition

$N$ = Normal time

$K(PF\&D)$ = Personal, Fatigue, and Delay factor from Section 5.1

$K(S)$ = Skill factor from Section 5.2

$K(L)$ = Learning factor from Section 5.3 after t hours or units of repetition

$K(e)$ = Error or variability factor for the difference between actual and predicted time for an operation. Note that $K(e)$ is a function of sample size.

37

The accuracy possible with the prediction of mechanical maintenance times by means of elemental standard data is shown in Figure 5.0-1.

Perfect correlation between predicted and demonstrated times fall on a 45-deg line (for equal times on each axis). Problem equipment that fails to meet the standard time is also readily observed.
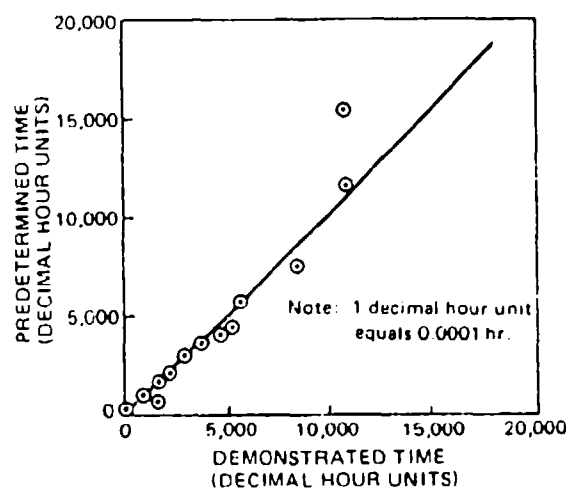


Figure 5.0-1: LRU Removal and Replacement - All Systems

Similar results should be possible with the data provided in Section 7.0 for the maintenance of electronics.

## 5.1 Personal, Fatigue, and Delay Factors

The remainder of this section has been abstracted from Appendix II of Reference 5-1.

### PERSONAL, FATIGUE AND DELAY (PF&D) ALLOWANCES

#### General

Personal, Fatigue, and Delay (PF&D) is the time allowed a worker to compensate for attending to personal needs, for fatigue, and for delay occurring due to conditions beyond his control. This time is additive to the normal time required to accomplish a job. The inclusion of this allowance is common practice in the development of a labor standard. Present practices for computing PF&D have resulted in varied interpretation of the factors being considered and the use of different techniques to establish them. Variances in application range from an allowance for each element within a standard to the adoption of a fixed or blanket allowance for all standards in an organization or activity. As a result of these different practices, standards for identical work are inconsistent and result in different measurement criteria for identical jobs or functions and incomparable data at the summary levels. In order to minimize these variances, it is necessary to establish a standardized method of computing the PF&D allowances. The guidelines for developing allowances portrayed in this appendix have been accepted and used extensively for some time throughout the Department of Defense, and are established as the standardized method.

Where appropriate, a fixed PF&D allowance based on the standardized method may be developed one time for a specific function or for groups of personnel doing similar work under similar conditions. The fixed allowance applies to all standards in the function or group and precludes the need to individually compute the allowance for each standard. In work situations where the guidelines are not applicable, the fixed allowance will be developed through work measurement techniques such as time study or work sampling.

#### Conditions for Consideration

The development and application of PF&D allowances requires that the various conditions under which a job is performed be examined and considered. To insure that all conditions are considered, separate factors are provided for each of the three areas; Personal, Fatigue, and Delay. Analysts/ technicians must be completely objective in establishing the allowances which correctly reflect the true situations inherent to the job.

#### Allowances for Personal Time

Consider the surroundings, working conditions, and job requirements which cause the employee to stop work from time to time to attend to necessary personal needs, (go to restroom, get a drink of water, get fresh air, etc). Since most operations allow two breaks of 10 minutes each during the 480-minute shift, the basic allowance for

39

this factor will be 4.2 percent (20.0 minutes). If facilities layout or management policy dictate that longer break periods are required, it will be necessary to recompute the percentage for the Basic allowance subject to approval of higher authority.

|  | Percent |
|---|---|
| Basic Allowance | 4.2 |

Add:

|  |  |  |
|---|---|---|
| a. | Normal office conditions | 0 |
| b. | Normal shop, central heat, slightly dirty or greasy | 1 |
| c. | Slightly disagreeable conditions. Exposed to inclement weather part of time, poor heating, or poor cooling. | 3 |
| d. | Exposed to extremely disagreeable conditions most of time. Proximity to hot objects, continuous exposure to disagreeable odors and fumes, or to excessive temperature ranges. | 6 |

Add the following where applicable:

a. Where time is allowed by management at the beginning of the shift to make ready and/or at the end of the shift to get/put away tools and equipment, clean up work area, or to don/remove special work clothing (aprons, smocks, etc.) allowances are as follows:

| TOTAL MINUTES ALLOWED FOR PREPARATION AND CLEANUP | % ALLOWANCE |
|---|---|
| 5 | 1.0 |
| 10 | 2.1 |
| 15 | 3.1 |
| 20 | 4.2 |

NOTE: In "super-clean" room conditions, use (b) below to supplement these allowances.

b. Adjunctive allowance - allowed for work performed   4.0
in "super" clean rooms. Required when operators
must utilize special clothing, which includes
caps, boots, etc., and remove it when leaving
work area. This includes time to invest or di-
vest special clothing at beginning and ending of
shift, at lunch, and for personal requirements.

c. Where the work period is 8 consecutive hours and   4.2
20 minutes lunch period is allowed at the expense
of the Government.

40

## Allowances for Fatigue

Physical: Consider the average weight handled per man and only those elements of time that the man is under load to determine percentage (total time for under load elements divided by base time and use the closest percentage on the chart). Also, consider the height that load must be manually lifted (average situation).

a. Weight Allowances. The percent allowances given below are based on the effective net weight being handled in the area between knees and chest. Chart also applies to laying weight on floor or low skid, or to sliding or rolling objects along a plane.

| Effective Net | Percent of time under load | | | | |
|---|---|---|---|---|---|
| Weight Handled | 1-12 | 13-25 | 26-50 | 51-75 | 76-100 |
| 1-10 | 0 | 1 | 2 | 3 | 4 |
| 11-20 | 1 | 3 | 5 | 7 | 10 |
| 21-30 | 2 | 4 | 9 | 13 | 17 |
| 31-40 | 3 | 6 | 13 | 19 | 25 |
| 41-50 | 5 | 9 | 17 | 25 | 34 |
| 51-60 | 6 | 11 | 22 | x | x |
| 61-70 | 7 | 14 | 28 | x | x |
| 71-80 | 8 | 17 | 34 | x | x |

x - Study individual job for improvement considering job enlargement, mechanical aids, worker rotation or other stress relieving aids.

Table values will be multiplied by the following factors as dictated by conditions:

| | |
|---|---|
| For picking up load from floor, multiply basic allowance by | 1.10 |
| For placing load above chest-height, multiply basic allowance by | 1.20 |
| For getting load from above chest-height, multiply basic allowance by | 0.50 |

The application of the factors from this table in the computation formula on page 37 will normally provide a realistic PF&D allowance. However, in some instances the use of these factors results in an unrealistic, zero or negative denominator in the formula. When this occurs, assuming all factors are defined correctly, it will be necessary to combine related elements or standards into higher levels until a realistic allowance is obtained. "Realistic" is defined as an allowance acceptable to the worker, the supervisor, and the analyst.

b. To determine the effective net weight for sliding or rolling objects the weight must be multiplied by following coefficients of friction:

## Coefficients of Friction (Average Values)

| Surface | Friction Coefficient |
|---------|----------------------|
| Wood on Wood | 0.4 |
| Wood on Metal | 0.4 |
| Metal on Metal | 0.3 |

Example: Worker sliding a 40 lb. casting from metal conveyor
to wood work bench. ENW = 40 lbs. x .4 = 16 lbs.

Position: Consider the position which the employees must assume
to perform the operation. Select the class which best describes the
average condition. It is assumed that the job will be less tiresome
if the position can be varied frequently.

| Class | Percent |
|-------|---------|
| a. Sitting or standing | 0 |
| b. Sitting | 1 |
| c. Walking | 1 |
| d. Standing | 2 |
| e. Climbing or descending ramps, stairs or ladder | 4 |
| f. Working in close, cramped position | 7 |

Mental: Consider the degree of concentration necessary to
perform the job and the amount of variety in the tasks. Highly
repetitive jobs should be low in this factor.

| Class | Percent |
|-------|---------|
| a. Work largely committed to habit; simple calculations on paper, reading easily understood material such as routine or familiar instructions, counting and recording, simple inspection requiring attention but little discretion, arranging papers by letter or number. | 0 |
| b. Work requires full attention; copying numbers, addresses or instructions, memory of part number, name while checking stock or parts list, simple division of attention between work at hand and jobs of others, conveyor or time schedule, simple calculations in head, filing papers by subject of familiar nature. | 2 |
| c. Work requires concentrated attention; reading of nonroutine instructions, routine calculations on paper such as long division and four-place multiplication, checking numbers, parts, papers, etc., | |

requiring cross check or double check, division
of attention between three components such as
accounting, inspecting, and grading or driving
over unfamiliar route, watching vehicle, traffic
and route signs.     4

   d.  Work requires deep concentration; swift mental cal-
culations or calculations on paper, memorizing,
inspection work requiring interpretation and dis-
cretion of unfamiliar nature, as when working
against nonroutine specifications, highly divided
attention between phases of work, operations of
others, hazards, etc.     8

Lighting: Consider the amount of light on the working surface
in relation to the fineness of details upon which the operator works.
Consider the amount of glare on the work surface and rapid changing
or "hypnotic" effect on the work surface.

| Class | Percent |
|---|---|
| Continual glare on work areas - Work requiring constant change in light on work area. Less than 75 foot candle power on work surface for normal job. Less than 125 foot candle power on work surface for close work. | 2 |

Noise Factor: Consider the general noise of the work areas as
well as any annoying, sharp, staccato, or intermittent noises
occurring during more than 50% of the work day. If ear plugs or
ear muffs are worn, their sound deadening effect must be considered
when using this allowance.

| | Class | Percent |
|---|---|---|
| a. | Constant, rather loud noises such as in machine shops, motor test shops, etc. (over 60 decibels) | 1 |
| b. | Average constant noise level but with loud, sharp, intermittent, or staccato noise such as nearby riveters, punch presses, etc. (Example: sheet metal shop). | 2 |

Monotony: Consider the fatigue resulting from fast, highly
repetitive operations. The cycle is the time elapsed from start-
ing one element until the same element is started again.

| Cycle Time | Percent |
|---|---|
| a. 0.00-0.20 minutes | 4 |
| b. 0.21-0.40 minutes | 3 |
| c. 0.41-0.80 minutes | 2 |
| d. 0.81-2.50 minutes | 1 |
| e. 2.51 minutes or more | 0 |

Restrictive Safety Devices and Clothing: Consider those devices which are required by the job and which cause fatigue when worn. No allowance should be made here unless it is necessary to remove the device occasionally for relief, or if wearing them causes fatigue. If more than one device is required, add the allowances.

| Class | Percent |
|---|---|
| a. Face shield | 2 |
| b. Rubber boots | 2 |
| c. Goggles or welding mask | 3 |
| d. Tight, heavy protective clothing | 4 |
| e. Filter mask | 5 |
| f. Safety glasses | 0 |

## Allowances for Delay

Consider the job in relation to adjacent jobs--how long can any adjacent job be shut down before the job being studied is affected? Also, consider other delays inherent in the job, such as supervisory interruptions, moving from one work station to another, waiting for cranes, etc. No delays which can be prevented by the employee should be considered here.

Basic Allowance

| Class | Percent |
|---|---|
| a. Isolated job. Little coordination with adjacent jobs | 1 |
| b. Fairly close coordination with adjacent jobs | 2 |

Balancing Delay. Where employees are required to move from one work station to another to balance adjacent stations, add the following:

| | | |
|---|---|---|
| a. Move once each 5 minutes | | 5 |
| b. Move once each 30 minutes | | 3 |
| c. Move once each 60 minutes | | 2 |
| d. Move once each 2 hours | | 0 |

44

## 5.2. Skill Level Allowance

In order to predict labor requirements, the normal time, synthesized from the data in Section 7.0 can be multiplied by K(S), where K(S) is obtained from Table 5.2-1, adapted from Reference 5-2.

TABLE 5.2-1:  SKILL LEVEL FACTORS, K(S)

| K(S) | DESCRIPTION |
|---|---|
| 2.00 | Very slow; clumsy, fumbling movements; operator appears half asleep, with no interest in the job. |
| 1.50 | Steady, deliberate, unhurried performance, as of a worker not on piecework but under proper supervision; looks slow, but time is not being intentionally wasted while under observation. |
| 1.00 (Standard Rating) | Brisk, businesslike performance, as of an average qualified worker on piecework; necessary standard of quality and accuracy achieved with confidence. |
| 0.80 | Very fast; operator exhibits a high degree of assurance, dexterity, and coordination of movement, well above that of an average trained worker. |
| 0.67 | Exceptionally fast, requires intense effort and concentration, and is unlikely to be kept up for long period; a "virtuoso" performance only achieved by a few outstanding workers. |

The factors in Table 5.2-1 are not a function of the number of times a specific task has been performed, but represent the range of variability in

45

workers due to differences in skill. The classification does not imply that workers always remain in a given category. Skill levels can and do change over time.

## 5.3 Learning

The learning process for electronic maintenance technicians involves the accumulation of cognitive skills by means of repetition of a given task. The development of manual dexterity is generally a result of highly repetitive production operations and is probably not a significant factor for electronics maintenance. A review of several alternative methods for defining task time as a function of the cumulative experience of the task is provided in Reference 5-3. The time constant model advocated is of the form:

$$K(L) = (\ Y(C) + Y(f) \times (1-e^{-t/tau})\ )^{-1}$$
$$T(t) = N \times K(L)$$

Where:

$N$ = Normal time
$K(L)$ = Learning-curve factor
$T(t)$ = Expected task time after "t" hours of repetition
$Y(c)$ = Output index for time t = 0
$Y(c) + Y(f)$ = Output index for time t = infinity
$tau$ = Learning time constant

Data presented by Towill and Bevis, Reference 5-4, for eight trainees performing electronic assembly, yield values of:

$Y(c)$ = 33.6%
$Y(f)$ = 66.4%
$tau$ = 3045 units x 4.14 minutes/unit
= 210 hours

Example:

Normal time for assembling an electronic unit is 0.2 hr. Determination of the expected time for an average trainee who has removed five units is obtained as follows:

$$N = 0.2$$
$$Y(c) = 0.336$$
$$Y(f) = 0.664$$
$$tau = 210$$
$$t = 0.2 \times 5 \text{ hours}$$
$$K(L) = (.336 + .664 (1 - e^{-1/210}))^{-1}$$
$$= (.336 + .664 (1 - .99525))^{-1}$$
$$= (.336 + .003)^{-1}$$
$$= 2.95$$

The expected task time for the fifth unit ($t = 1$ hour) is thus given by:

$$T(t) = N \times K(L)$$
$$= 0.2 \times 2.95$$
$$= 0.59 \text{ hours}$$

## 5.4 Chemical Warfare Ensemble

At elevated temperatures, heat stress becomes the overriding factor. Table 5.4-1 (Reference 5-5) provides both the maximum time and the recommended work and rest cycle times for elevated temperatures, and should be used to supplement PF&D allowances for normal ambient temperatures.

## TABLE 5.4-1:  SAFETY ALLOWANCES FOR CHEMICAL WARFARE ENSEMBLE

WARNING: THIS TABLE IS INTENDED AS A GUIDE ONLY.  IF SIGNIFICANT HEAT STRESS OCCURS USING THIS GUIDANCE, SUPERVISORS SHOULD CONSULT WITH LOCAL MEDICAL SERVICE PERSONNEL.

### GROUND SUPPORT ENSEMBLE

MAXIMUM TIME (MINUTES) WITH MINIMUM HEAT STRESS EFFECT
AIR TEMPERATURE RANGES (F)

| ENSEMBLE CONFIGURATIONS | WORKLOAD | LESS THAN 70 | 70-79 | 80-89 | 90* |
|---|---|---|---|---|---|
| CHARCOAL OVERGARMENT OVER FATIGUE WITH PROTECTIVE MASK, HOOD GLOVES, AND BOOTS. | LOW MODERATE HEAVY | XXX 200 60 | XXX 115 50 | 160 65 40 | 80 40 30 |
| FATIGUES WITH PROTECTIVE MASK, HOOD AND GLOVES. | LOW MODERATE HEAVY | XXX XXX 300 | XXX XXX 170 | XXX 120 65 | 120 65 45 |

*FOR TEMPERATURE IN EXCESS OF 90, WORKTIME WILL BE SEVERELY LIMITED.

### SUPERVISOR INFORMATION

WORK/REST CYCLE TIME (MINUTES) WITH MINIMAL HEAT STRESS EFFECTS
AIR TEMPERATURE RANGES (F)

| ENSEMBLE CONFIGURATIONS | WORKLOAD | LESS THAN 70 | 70-79 | 80-89 | 90* |
|---|---|---|---|---|---|
| CHARCOAL OVERGARMENT OVER FATIGUES WITH PROTECTIVE MASK, HOOD, GLOVES, AND BOOTS. | LOW MODERATE HEAVY | XXX 40/20 20/25 | XXX 30/25 15/30 | 40/30 20/40 10/50 | 20/50 10/60 5/70 |
| FATIGUE WITH PROTECTIVE MASK, HOOD, AND GLOVES. | LOW MODERATE HEAVY | XXX XXX 60/30 | XXX XXX 45/30 | XXX 50/35 20/30 | 50/50 30/60 15/45 |

* FOR TEMPERATURE IN EXCESS OF 90, WORKTIME REQUIRIES REST CYCLES ARE PROHIBITIVELY RESTRICTED.

LOW WORKLOAD:  ADMINISTRATIVE WORK
MODERATE WORKLOAD:  MOST GROUND SUPPORT OPERATIONS.
HEAVY WORKLOAD:  BOMB-LOADING, HANDLING HEAVY EQUIPMENT, CONSTRUCTION TASKS.

XXX  – ANY REASONABLE WORK/REST CYCLE SHOULD PREVENT HEAT CASULTIES.

## 6.0 RECOMMENDATIONS FOR FUTURE WORK

The project described in the previous sections has been one of development rather than research. Existing methods and techniques have been used to develop the time standard data presented in Section 7.0. These data are the "conclusions" of the work and as the work progressed, several areas have come to light that might warrant further investigation. Recommendations for future work have therefore been made and constitute the remainder of Section 6.0.

### 6.1 Classification and Coding

The data in Section 7.0 have been classified with a mnemonic coding system that, after some use, permits rapid location of data without the need to refer to an index. However, the size of the data set of standards is approaching the capacity for its mnemonic coding system. Since a large number of maintenance analyses can be created from the time standards provided, their retrieval by a code that contains mnemonic fields requires the careful design of a suitable coding system. A taxonomy of equipment characteristics or maintenance operation characteristics, or both, is an alternative to the mnemonic approach. Most importantly, the system must be unambiguous if good retrieval capability and duplication of analyses are to be achieved. The benefit of the well-designed classification and coding system might be significant if the DOD decides to build a data bank of maintenance task times for specific electronic equipment.

### 6.2 Learning Curves and Skill Level

The development of "K" factors based on learning was addressed in Section 5.3. However, only one set of data was found for electronics and that was for manufacturing, not for maintenance. It appears that work is required that will correlate maintenance time for a given task with factors such as:

o   The number of times the worker has performed the task

o   Natural ability

o   Duration and specificity of training

o   The time between identical maintenance actions

o   Years of related experience and age

A knowledge of such factors would enable the results of maintenance task time analyses to be used for:

o   Development of life-cycle costs

o   Design trades between reliability and maintainability

o   Spares and manpower planning

o   Determination of cost optimized training and retraining schedules

It is therefore recommended that time standards be developed for some weapon system not yet in service and that data be collected to enable the above "K" factors to be calculated.  Where possible, variables such as training and skill level would be changed in a manner appropriate for a statistically designed experiment.

## 6.3 Abnormal Environments

Alluisi and Fleishman (Reference 6-1) provided more than 200 references on temporal factors and work rest cycles associated with human performance and productivity under abnormal conditions, including some that occur under military operations.  A review of these reports was outside the scope of the current contract but might yield factors relevant to planning for battle or other extenuating conditions.

No reports were found on conditions of weightlessness that apply to analysis of space station maintenance.  It is probable that the times for basic body motions, on which the standards in Section 7.0 are based, are significantly different for weightless conditions.  Of course there may be some factor of proportionality for the same body motions on the ground and in space.  Consideration should therefore be given to an analysis of existing records of different astronaut's body motions on the ground and in space to determine the "K" factor for space maintenance.

50

## 6.4 Failure Mode Rates

Two problems exist in determining fault isolation times. The first problem is the lack of suitable data on failure rates by mode. The second problem is the inordinate amount of work that is required to perform an analysis of contemporary electronic systems. There appears to be no easy solution to either of these problems.

For example, Figure 6.4-1 shows a part of a fault isolation procedure for a flight management computer.

FMC NAV DATA
LOADING PROBLEMS

PREREQUISITES
ELECTRICAL POWER (MM 24-22-00)
CB'S: 11E8,11E9,11E29,11E30

DID "UNIT FAIL" ANNUNCI-
ATOR ON DATA BASE LOADER
ILLUMINATE AFTER LOADER POWER-
ON SELF-TEST WAS COMPLETED?

NOTE: ALL LIGHTS ON DATA BASE
LOADER ILLUMINATE FOR
APPROXIMATELY 6 SECONDS
DURING POWER-ON SELF-
TEST SEQUENCE.

YES → PERFORM DATA LOADING
PROCEDURE USING A DIFFERENT
DATA BASE LOADER.

NO

DID "READ FAIL" ANNUNCI-
ATOR ON DATA BASE LOADER
ILLUMINATE AFTER LOADER POWER-
ON SELF-TEST WAS COMPLETED?

YES → PERFORM DATA LOADING
PROCEDURE USING A DIFFERENT
TAPE.
IF FAULT PERSISTS, VERIFY
DATA BASE LOADER INTERFACE
CABLE IS PROPERLY CONNECTED
TO FMC DATA BASE LOADER
CONNECTOR.

NO

DID "DATA XFR FAIL" ANNUN-
CIATOR ON DATA BASE LOADER
ILLUMINATE AFTER LOADER POWER-
ON SELF-TEST WAS COMPLETED?

OR

AFTER DATA LOAD WAS
COMPLETED, WAS "NAV DATA" OR
"ACTIVE" CYCLE DISPLAY ON CDU
"IDENT" PAGE BLANK?

YES → OPEN "FMCS CMPTR" CIRCUIT
BREAKER CORRESPONDING TO SIDE
THAT WAS BEING LOADED AND DIS-
CONNECT DATA BASE INTERFACE
CABLE. AFTER 15 SECONDS,
MINIMUM, CLOSE "FMCS CMPTR"
CIRCUIT BREAKER.
ENSURE "FMCS CMPTR"
CIRCUIT BREAKER CORRESPONDING
TO FMC THAT IS NOT BEING
LOADED IS OPEN AND RECONNECT
DATA BASE LOADER INTERFACE
CABLE.
REPEAT DATA LOADING PROCE-
DURE.
DOES FAULT PERSIST?

YES → REPLACE L (R) FMC M134
(M133)(MM 34-61-01).

NO → DATA LOADING OPERATION IS
FUNCTIONAL. NO ACTION
REQUIRED.

NO

DATA LOAD NORMAL.

Figure 6.4-1. Fault Isolation Procedures

Times for each of the maintenance actions called for in the procedure can be determined by synthesis from the standard times in Section 7.0. However, the average time taken for fault isolation is a function of the probability of following each route through the fault isolation tree. The probability of following each route is in turn dependent on the probability of failure of the piece parts of system, on the system architecture, and in most cases on the modes of failure of the piece parts. To complete the analysis, MIL-HDBK-217 or its equivalent would have to include failure rates by mode. A computerized method of analysis might then be developed to accomplish some of the combined failure mode and effect analysis, and fault isolation time analysis. Neither of these two tasks is trivial but the payoff in terms of improved fault isolation methods could be very significant.

# 7.0 CODING, STANDARD DATA, AND ENVIRONMENTS

This section provides the data required by an electronic system maintenance analyst for synthesizing maintenance task times. The data consist of:

o Details of the way in which each type standard data has been classified and coded to permit easy retrieval and referencing.

o Standard data from which times for electronic systems maintenance can be synthesized.

o Standard environments that can be used to define the conditions under which maintenance is assumed to be performed.

Section 7.2, which contains the standard times, is indexed by mnemonic code for easy location. The data used to develop the standards in Section 7.2 have been deposited with the Defense Industrial Resources Supply Office, Cameron Station, Alexandria, Virginia 22314.

## 7.1 Coding of Elemental Standards

Each elemental standard time is uniquely identified by a seven character code that is placed in the upper corner of the data sheet.

ETP-SE-X1                                                                      TIN WIRE

|  |  | TIN |  |  |
|---|---|---|---|---|
| FIRST | TMU | ADDITIONAL | TMU |
| 11 | 595 | X1 | 482 |

**Tin First**

Begins with reaching to soldering iron. Includes cleaning tip, positioning iron in holder, getting wire or solder, tinning wire or terminal. Ends with asiding wire or solder and soldering iron.

**Tin Additional**

Begins with cleaning tip. Includes getting wire or solder. Ends with tinning wire or terminal.
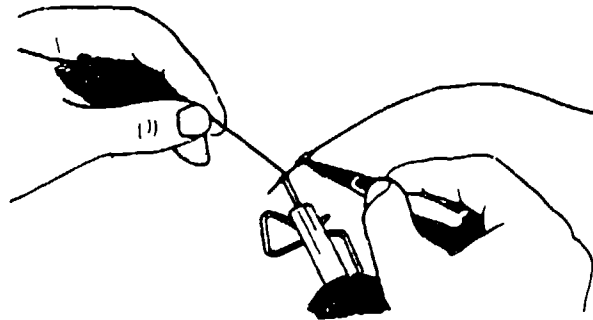


Figure 7.1-1 Mnemonic Classification Code

The code is mnemonic and is divided into three fields, the first of which is subdivided. The first character splits the data in two parts, and is either an "E" for electrical and electronic or an "O" for other. ("Other" contains the nonelectronic standards required to access or remove and replace equipment.)

The second and third characters describe the work category. Figure 7.1.1 has a "TP" for a "Tool, Powered" obtained from Table 7.1-1.

The fourth and fifth characters are qualifiers. For example, the SE of ETP-SE stands for "Solder, Electric" obtained from Table 7.1-2.

54

obtained from the body of the data sheet.

The sixth character, obtained from the body of the data sheet, identifies the following attributes:

- R     remove first piece
- I     install first piece
- Y     remove additional piece
- X     install additional piece
- O*    first piece, different than remove or install
- Z     additional piece, different from remove or install

* An "O" is also used in standards other than electronic.

The seventh character, obtained from the body of the data sheet, is either a number referring to a special case or an

- A or F for Very Easy
- B or G for Easy
- C or H for Moderate
- D or I for Difficult
- E or J for Very Difficult

# TABLE 7.1-1:  WORK CATEGORY CODES (2ND AND 3RD DIGIT)

Major actions being performed, or the type of equipment involved:

AC  Actuate

BM  Body Motion

CA  Calibrate

CL  Clea.

CP  Clamp

EL  Elemental

IT  Inspect

JP  Job Preparation/Termination

MH  Material Handling

NF  Nonthreaded Fastening

OH  Object Handling

PK  Package

PT  Process Time

RD  Read

ST  Surface Treat

TF  Threaded Fastner

TL  Tool Use, Hand

TP  Tool, Powered

WH  Wire Handling

WR  Write

## TABLE 7.1-2: WORK QUALIFIER CODES (4TH AND 5TH DIGIT)

| | | | |
|---|---|---|---|
| AC | Access | HC | Hand, Clean |
| BB | Black Box | HS | Hand, Simple |
| BF | Bolt, Finger | HT | Hold, Temporary |
| BL | Bundle Lace | IH | Insulation, Heat |
| BM | Bolt, Manual | IS | Insulation, Strip |
| BP | Bolt, Power | LA | Lay Aside |
| BS | Bond or Seal | LP | Latch, Pressure |
| BT | Bundle, Tie | MA | Manual |
| CA | Coat, Aerosol | MY | Magnify |
| CB | Connector, Bayonet | NT | Number Transfer |
| CC | Cord, Coil and Uncoil | OB | Object |
| CD | Climb or Descend | OD | Other Data |
| CE | Connector Electrical | OF | Obtain File |
| CF | Cap or Connector, Friction | OP | Obtain Part |
| CH | Camloc, High-Stress | PA | Protective Apparel |
| CL | Clock | PC | Printed Circuit |
| CM | Control, Manual | PD | Pliers Diagonal |
| CP | Cord, Plug | PN | Pin |
| CS | Cap, Screw | PO | Position |
| CT | Cable Tie | PT | Prose Transfer |
| DE | Disengage | RS | Repeat Sequence |
| DR | Drawer | RT | Ring, Tru-Arc |
| DS | Desolder | SA | Safety |
| EO | Envelope, Open | SC | Safety, Continuous |
| ER | Eyelet, Replace | SE | Solder, Electric |
| ET | Estimate | SM | Screw, Manual |
| EV | Examine, Visual | SP | Screw, Power |
| FT | Fasten | SR | Snap Ring |
| FX | Flux | ST | Safety, Twisted |
| GS | Glasses, Safety | TA | Test, Automatic |

TH  Test, Hand

TM  Technical Manual

TR  Tag, Routing

TS  Time Study

VA  Vise, Adjust

VS  Video Tape Standard

WC  Wire Crimp

WO  Walk Obstructed

WL  Wire Lock

WT  Wrench, Torque

WW  Wire Wrap

## 7.2 Elemental Standard Data

The standard data are divided into two data sets. The first set, prefaced by an "E" code, covers the work elements that apply to electronic equipment repair only. The second data set covers the other work elements, prefaced by an "0", consisting of elements that apply to other areas of maintenance.

The data are arranged in alphabetical order of mnemonic code.

7.2 Elemental Standard Data

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D1 | 1200 | Z1 | 670 |

## First

Begins with reaching to tool.  Includes locating adjust point, making adjustment, checking reading.  Ends with asiding tool.

## Additional

Begins with locating adjust point.  Includes positioning tool.  Ends with making adjustment.
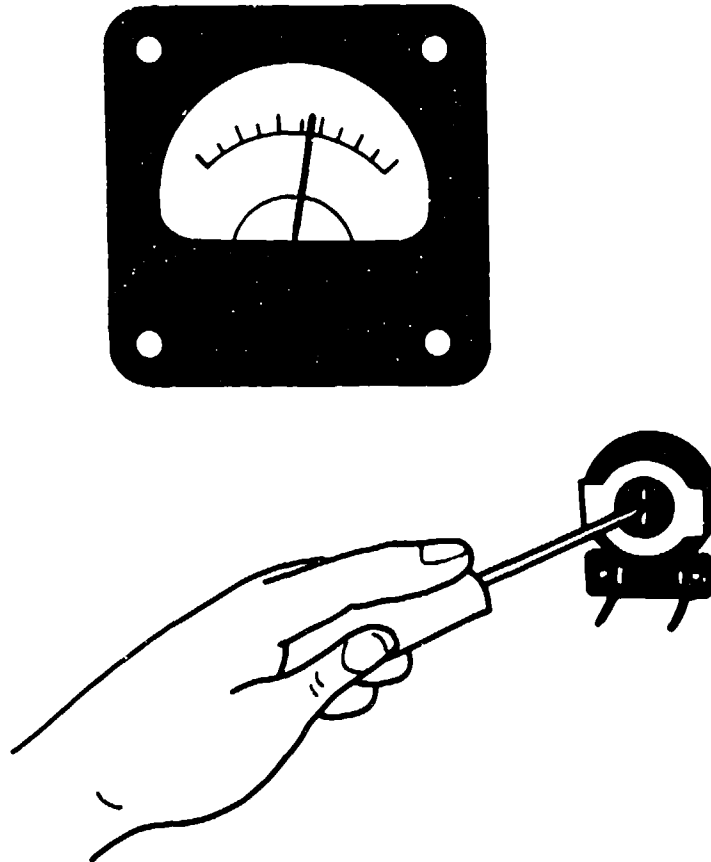
| FIRST | TMU |
|-------|------|
| D1 | 7950 |
| D2 | 4790 |

**First (D1) (Used With 50-ohm cable)**

Begins with setting controls on the Time Domain Reflectometer (TDR) tester. Includes adjusting TDR controls, removing dust caps from TDR and precision cable, connecting the precision cable to the TDR, calibrating TDR and adjusting CRT to obtain zero index with 50-ohm precision cable. Concludes (after test) with removing 50-ohm cable, stowing cable, and replacing dust caps.

**First (D2) (Used With Other Than 50-ohm Cable)**

Begins after setting-up tester for 50-ohm cable test. Includes getting appropriate impedance-matching adapter, removing dust caps, connecting adapter to 50-ohm precision cable, and adjusting controls to obtain zero index. Concludes (after test) with removing adapter cable, replacing dust caps, and stowing the adapter.

**Remarks**

Use with EIT-TA-D1, Coax Cable Test.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D1 | 229 | Z1 | 84 |

## First (Up to 3-in. stroke)

Begins with reaching to cleaning fluid. Includes removing and asiding cap, getting brush, wetting brush, cleaning flux from connection, asiding brush. Ends with getting and installing cap.

## Additional (Up to 3-in. stroke)

Begins with wetting brush. Ends with cleaning flux from connector.
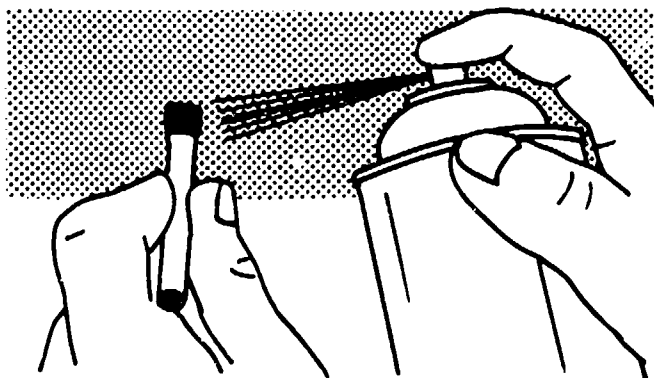
## REMOVE

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| R1    | 471 | Y1         | 308 |

### Remove First

Begins with reaching to printed circuit board.  Includes positioning board, getting heated tool, loosening conformal coating from terminal, asiding tool, getting vacuum, cleaning surface, releasing board.  Ends with asiding vacuum.

### Remove Additional

Begins with applying heated tool to terminal.  Includes loosening conformal coating from terminal.  Ends with cleaning additional area.
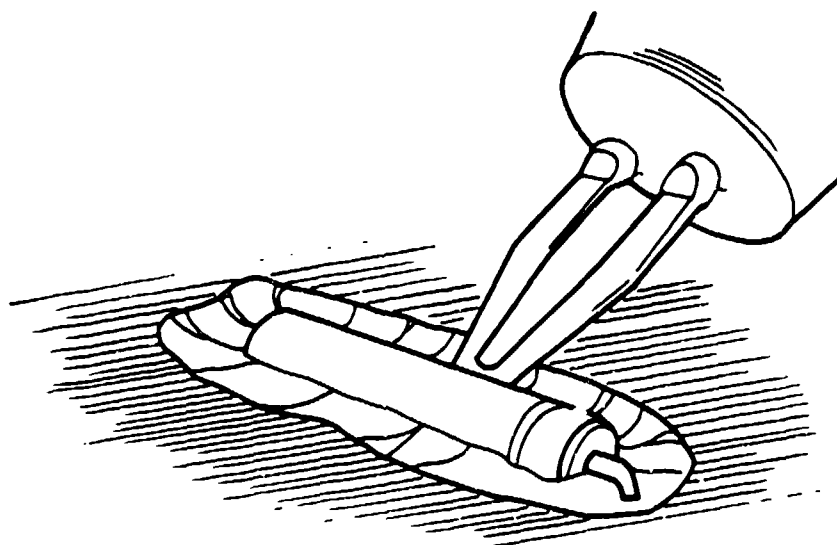
FIRST     TMU

01        38

## First

Beings with positioning iron to sponge.  Includes wiping tip, regrasping iron, positioning iron back to sponge.  Ends with wiping tip on other side.
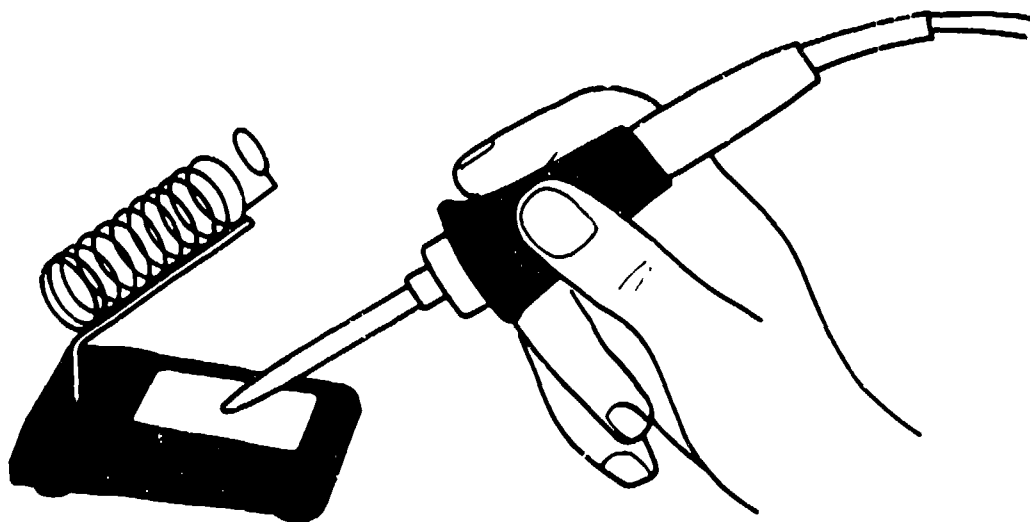
FIRST      TMU

01         2704

### First

Begins with connecting the cable to be tested to adapter.  Includes setting
feet/division scale on TDR, checking zero adjustment, adjusting zero
reference, adjusting distance dial to set pulse of graticule line, making
final adjustments, actuating test switch, reading fault location indicator.
Ends with disconnecting cable tested.

### Remarks

Use with ECA-TA-01/02 Time Domain Reflectometer calibration.
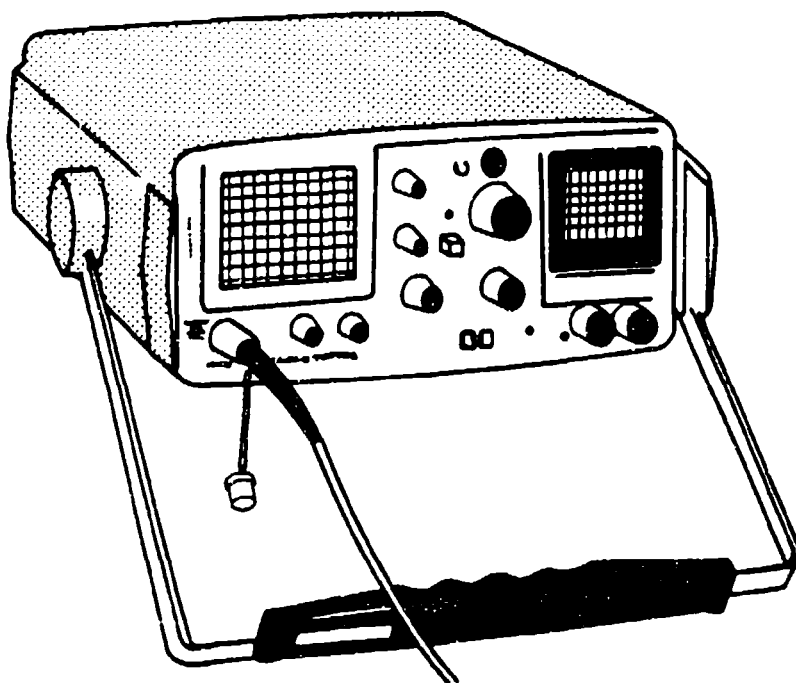
|        | FIRST | TMU |
|--------|-------|-----|
|        | D2    | 630 |

## First

Begins with reaching to test leads.  Includes installing test leads, positioning low-drive switch, observing good/bad indication, device polarity, and base lead identification, positioning high-drive switch, observing good/bad indication, device polarity, and base lead identification, positioning switch off.  Ends with disconnecting test leads.
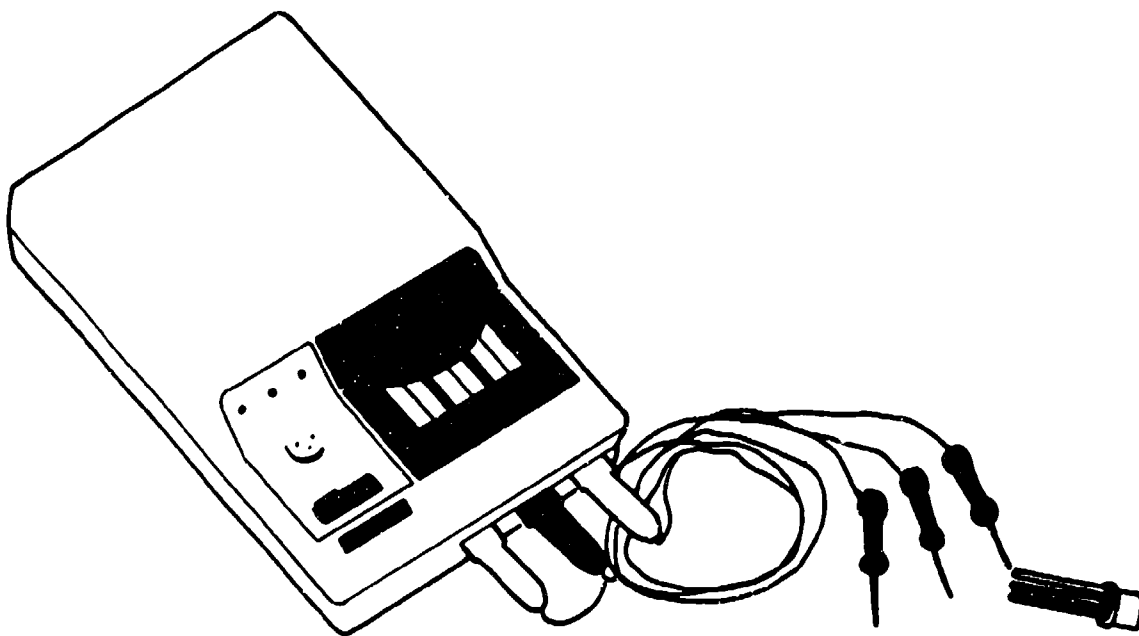
| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D1 | 1146 | Z1 | 776 |

## First

Begins with getting megger, uncoiling leads. Includes installing test leads, cranking megger, checking meter indication, disconnecting and coiling test leads. Ends with asiding megger.

## Additional

Begins with installing test leads, cranking megger. Ends with disconnecting test leads.
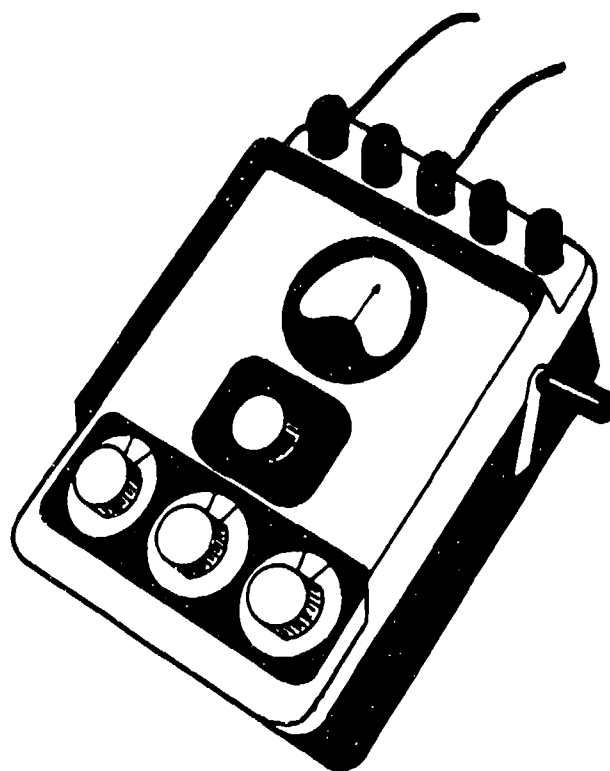
| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D2 | 4440 | Z2 | 2600 |

## First

Begins with connecting equipment. Includes loosening binding posts,
positioning leads, tightening binding posts, installing and removing leads to
test instrument, actuating selector switch, selecting current, setting
voltage, adjusting coarse and fine controls, reading indications, adjusting
decade half scale, turning down coarse and fine controls, adjusting decade,
presetting voltage, adjusting coarse and fine controls, comparing readings,
turning coarse and fine controls down, decade to zero, selector down. Ends
with disconnecting equipment.

## Additional

Begins with turning selector to current. Includes selecting voltage,
adjusting coarse and fine controls, comparing indications, adjusting decade
half scale, turning down coarse and fine control, presetting voltage selector
to proper range, adjusting coarse and fine controls, comparing readings.
Turning fine and coarse controls down, decade back to zero and selector down.
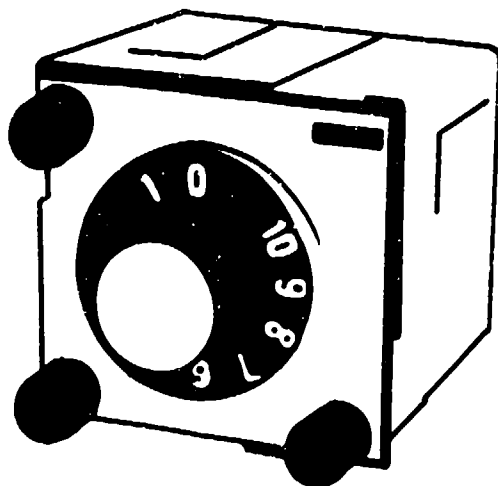
| | FIRST | TMU | ADDITIONAL | TMU |
|---|---|---|---|---|
| | D3 | 3040 | Z3 | 990 |

## First

Begins with connecting equipment. Includes loosening binding posts,
positioning leads, tightening binding posts, installing and removing leads to
test instrument, selecting "ohms", verifying decade is set at zero, turning
selector to proper range, adjusting zero control, actuating decade switch as
required to obtain resistance reading, returning decade to zero. Ends with
equipment disconnect which includes loosening binding posts, removing test
leads, and tightening binding posts.

## Additional

Begins with turning selector to proper range. Includes adjusting zero
control, actuating the decade switch as required to obtain resistance reading.
Ends with returning decade to zero.
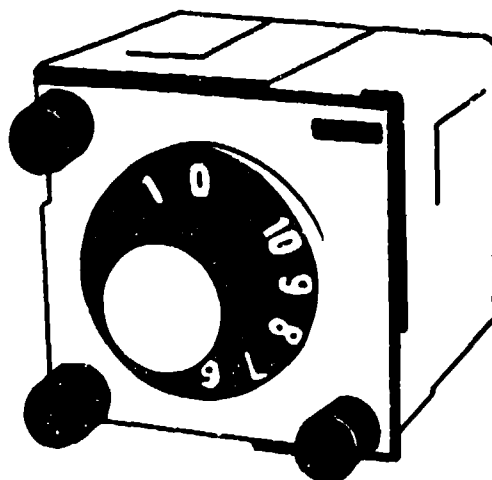
|       | FIRST | TMU  |
|-------|-------|------|
|       | 04    | 1420 |

**First**

Begins with reaching to test leads.  Includes positioning leads on test points, positioning ratio arm dial, actuating BA and GA switches, adjusting measuring arm dial, reading dials, removing and asiding test leads.

Remarks:  Wheatstone bridge on a test bench ready for use.

| FIRST | TMU |
|-------|-----|
| D5    | 520 |

## First

Begins with reaching to probe.  Includes connecting probe leads, actuating logic family switch or logic pulser switch, positioning probe to test point, observing indicator light.  Ends with disconnecting leads and asiding probe.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D6    | 926 | Z6         | 296 |

## First

Begins with reaching to volt/ohm meter.  Includes positioning test leads in meter, selecting scale, zeroing meter, positioning probes to test points, reading meter indication, disengaging probes and leads.  Ends with asiding meter.

## Additional

Begins with probes in hand, includes occasional resetting of meter scale, positioning probes to test points, reading meter indication.
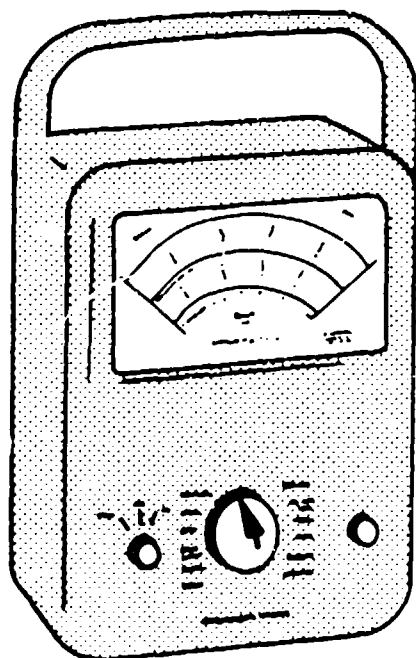
| FIRST | TMU |
|-------|-----|
| D7    | 640 |

### First

Begins with reaching to current tracer.  Includes positioning tracer probe, adjusting light sensitivity and observ  indication.  Ends with asiding probe.
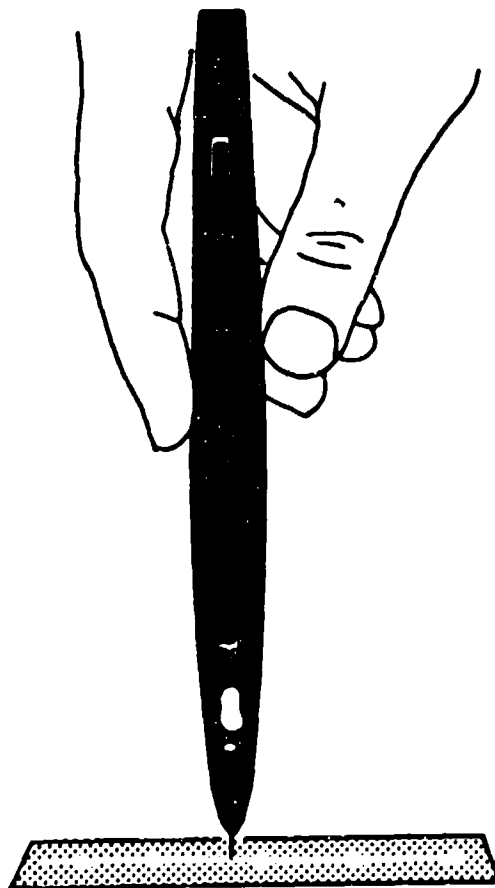
| REMOVE | | INSTALL | |
|--------|--|---------|--|
| FIRST | TMU | FIRST | TMU |
| R1 | 77 | I1 | 104 |

## Install

Begins with reaching to strap and ground cord.  Includes all motions for installing strap to body and attaching ground cord to reliable ground.

## Remove

Begins with reaching to ground cord and strap.  Includes all motions for disengaging ground cord and strap.  Ends with laying aside ground cord and strap.
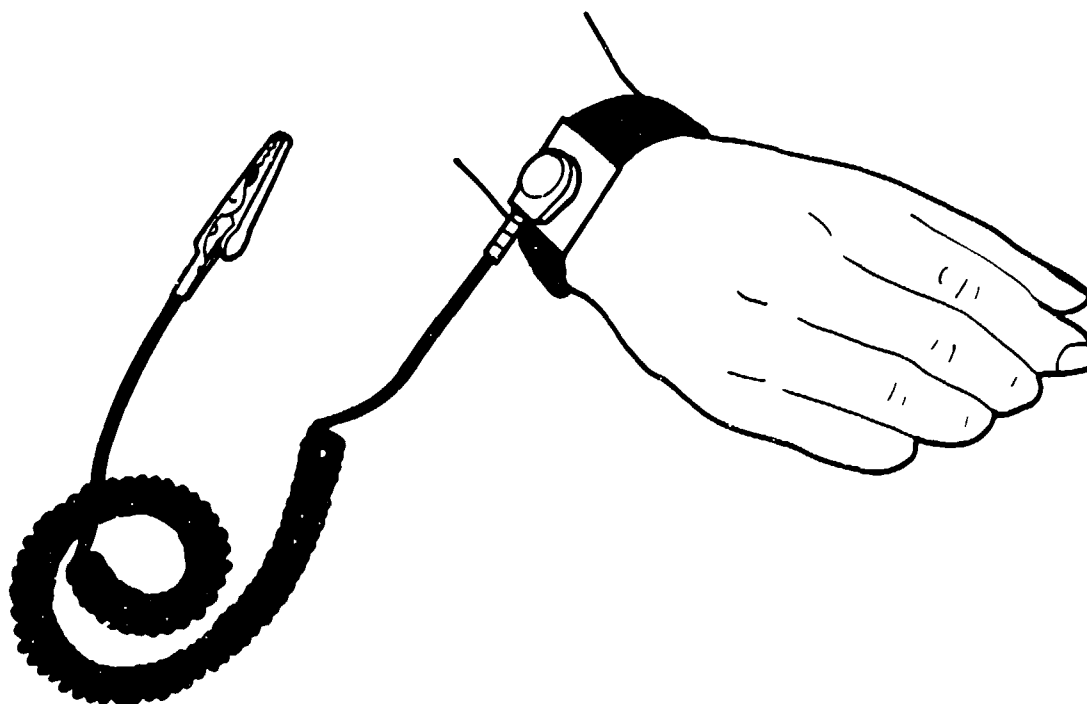
|        |       |
|--------|-------|
| FIRST  | TMU   |
| 01     | 700   |

## Preheating Printed Circuit Board

Begins with getting PCB and positioning it on heater.  Includes adjusting heater temperature, turning heater on, allowing board to heat, turning heater off, and ends with removing board from heater.

## Remarks

To be used when installing or removing surface mounted devices on PCB approved for preheating.

Analysis based on preheater HG3-2 manufactured by Manix, Division of Henry Mann Inc.
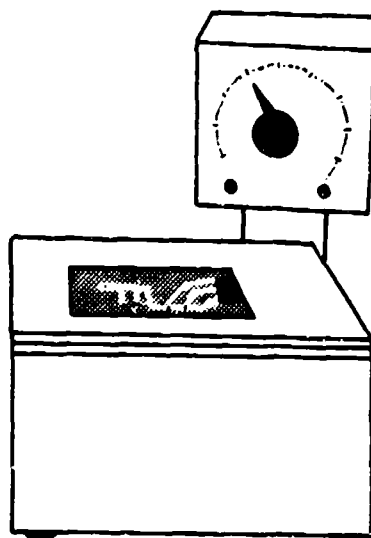
| JOB PREPARATION | TMU | JOB TERMINATION | TMU |
|:---:|:---:|:---:|:---:|
| 01 | 7101 | 02 | 3600 |

## Job Preparation

Begins with getting and installing interface unit, including walking to and from interface unit storage, installing power cables to interface display, installing circuit board to be tested, walking to magnetic tape storage, selection of tape, walking to tape drive, installation of tape of drive unit, walking to keyboard. Ends with typing required information on keyboard.

## Job Termination

Begins with hand-rewinding of magnetic tape, unlocking tape from drive unit, removing tape, walking with tape to tape storage, asiding tape, walking to printer, removing printout, walking to interface display unit, removing circuit board tested, carrying circuit board to work bench and return, removing unit from test set, carrying interface unit to storage unit. Ends with walking to work bench.

## Remarks

For probe of test points, use ETL-TA-XX.

| INSTALL | TMU |
|---------|-----|
| 01 | 1510 |

## Install

Begins with positioning device in holder. Includes opening door, positioning
device and holder under lamp, closing door, setting timer, allowing for cure
time, opening door, removing device and holder from chamber, closing door,
removing device from holder. Ends with inspecting for proper cure.

## Remarks

Ultraviolet lamp, 2kw, 200w per in.
Adhesive type MR-8153R, Panasonic Industrial Co.

| INSTALL | TMU |
|---------|-------|
| D2 | 9570 |
| D3 | 26270 |

## Install

Begins with positioning device in holder.  Includes opening oven door,
positioning device and holder in oven, closing oven door, setting timer,
allowing for type of adhesive, turning off oven, opening oven door, removing
device and holder from oven, closing oven door, removing device from holder.
Ends with inspecting adhesive for proper cure.

## Remarks

Oven is preheated to $150^{o}$C.

Adhesive Type:

D2:  MR-8153R, Panasonic Industrial Co. or 124-1, Ablestik Labs
D3:  DE-7, Epoxy Technology

|   REMOVE |     |   INSTALL |     |
|------|-----|------|-----|
| RA   | 80  | IA   | 160 |
| RB   | 130 | IB   | 220 |
| RC   | 190 | IC   | 330 |
| RD   | 280 | ID   | 500 |
| RE   | 390 | IE   | 750 |

### Remove

Begins with visually selecting cable-mounted connector to be removed.
Includes loosening and removing bayonet-type collar and disengaging cable-
mounted connector from fixed connector alone or in a group.  Ends with
releasing or laying aside cable-mounted connector.

### Install

Begins with reaching to cable-mounted connector alone or in group.  Includes
reading cable number, visually selecting matching fixed connector and engaging
cable-mounted connector.  Ends with twisting to secure bayonet-type collar.

### Remarks

Applies to Bendix PT-06 series connectors and similar.

Not applicable to coax connectors (OTF-CE).

Case variable factors:  distance 10%, weight 5%, control 85%.

(Identical to NALC code ONF-CB-XX).
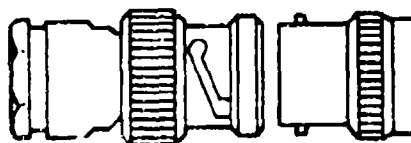
| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| RB | 2132 | IB | 2350 |
| RC | 3052 | IC | 3520 |
| RD | 4112 | ID | 5160 |

## Remove

Begins with selecting cable-mounted connector to be removed. Includes reaching to tool, loosening jackscrews, disengaging connector from fixed connector. Ends with capping both fixed and loose connectors and asiding loose connector and tool.

## Install

Begins with selecting cable-mounted connector to be installed. Includes removing caps from both loose and fixed connectors, positioning loose connector on fixed connector, reaching for tool and tightening jackscrews. Ends with asiding tool.
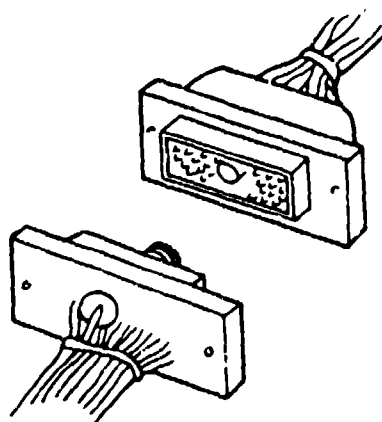
| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| RB | 312 | IB | 430 |
| RC | 412 | IC | 600 |
| RD | 592 | ID | 1010 |

## Remove

Begins with visually selecting cable-mounted connector to be removed.
Includes disengagement of cable-mounted connector from fixed connector.  Ends
with capping both loose and fixed connector and asiding loose connector.

## Install

Begins with selecting cable-mounted connector to be installed.  Includes
removing caps from both loose and fixed connectors, positioning loose
connector on fixed connector.  Ends with applying pressure to mate the
connectors.
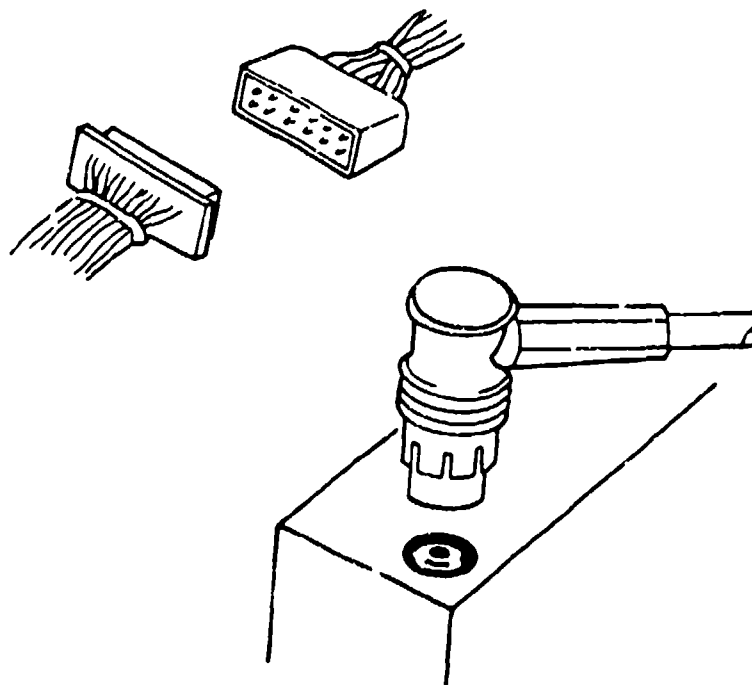
| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| R1 | 417 | I1 | 2270 |

### Remove

Begins with positioning PCB on drill press, aligning eyelet with drill, actuating handle to lower bit to eyelet, applying pressure to drill through eyelet. Ends with raising drill.

### Install

Begins with positioning PCB for work, positioning eyelet in board, moving PCB to arbor press, positioning board in press, securing eyelet by actuating press. Ends with examining installation and asiding board.

INSTALL

| FIRST | TMU |
|-------|-----|
| I1    | 214 |

## First

Begins with reaching to adhesive. Includes removing cap, applying adhesive to PCB, asiding adhesive, replacing cap, getting dual inline package (DIP) or flatpack, getting positioning tool, positioning tool to DIP or flatpack, positioning DIP or flatpack to PCB, releasing tool. Ends with asiding tool.
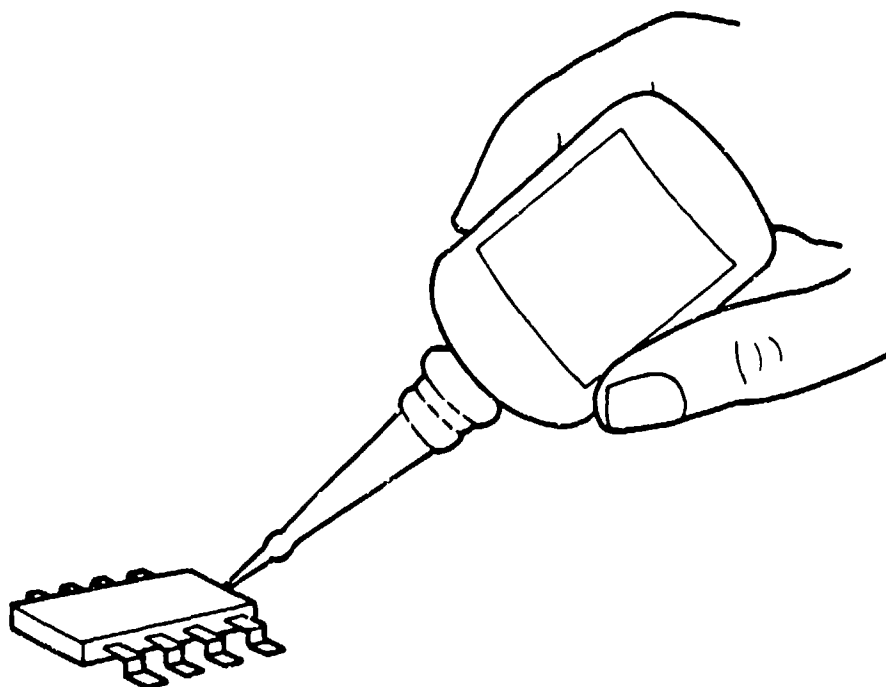
INSTALL

FIRST     TMU

I1        433

## First

Begins with reaching to DIP or discrete.  Includes getting positioning tool, positioning tool to DIP or discrete, positioning DIP or discrete to PCB, releasing and asiding tool, getting, applying, and asiding flux, getting and cleaning iron tip, getting solder, tacking on lead.  Ends with asiding solder and iron.
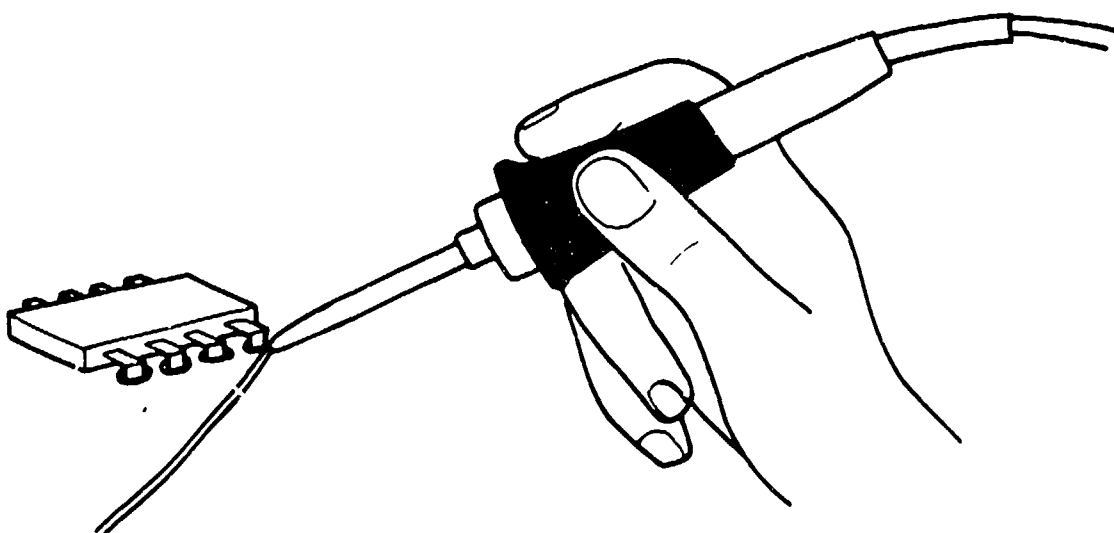
| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01    | 122 | Z1         | 40  |

## First

Begins with reaching to open or closed flux bottle.  Includes removing cap,
positioning flux bottle, applying flux, replacing cap.  Ends with asiding flux
bottle.

## Additional

Begins with positioning flux bottle.  Ends with applying flux.
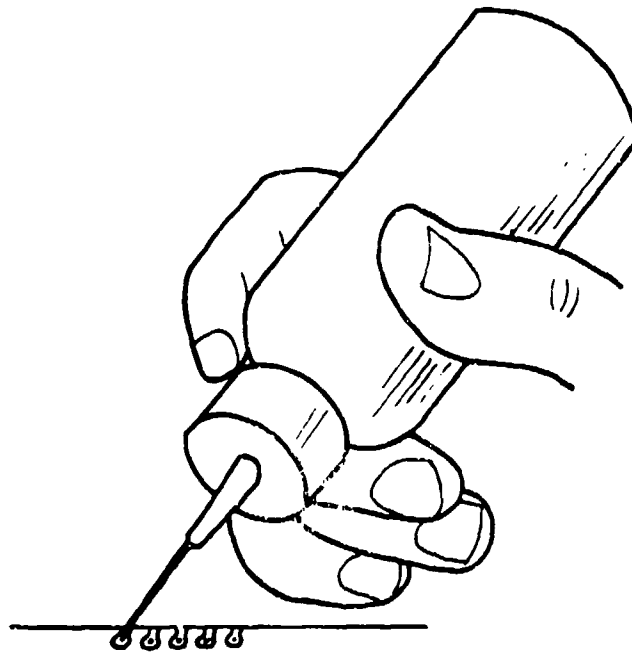
| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| R1     | 497 | I1      | 730 |

## Remove

Begins with reaching to latch and releasing latch (Hollingshead), rotating knob, checking for red band and rotating keeper (Tridair).  Ends with disengaging extractor.

## Install

Begins with positioning the hold down/extrator, rotating the keeper (Tridair only), tightening knob, repositioning LRU, final tightening of knob.  Ends with checking red band for proper exposure.
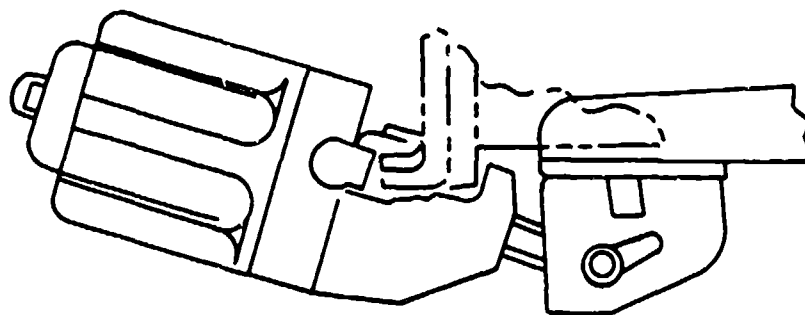


HOLLINGSHEAD



TRIDAIR

86
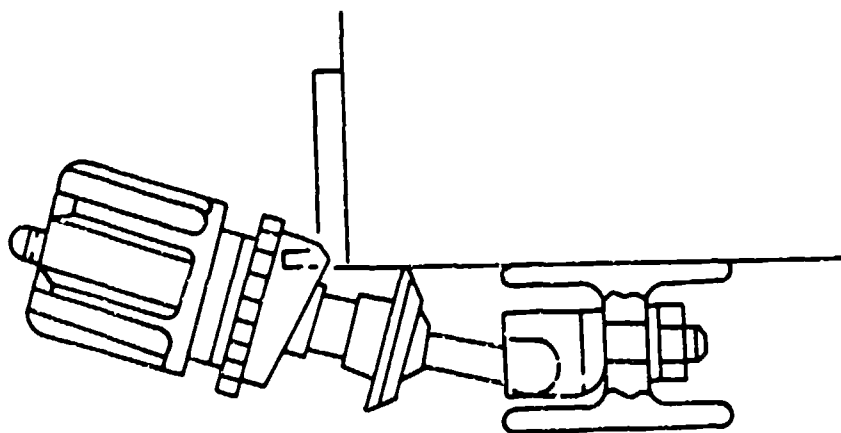
| | REMOVE | TMU | INSTALL | TMU |
|---|---|---|---|---|
| **1/4 to 1 inch** | | | | |
| | RA | 470 | IA | 580 |
| | RB | 570 | IB | 680 |
| | RC | 710 | IC | 850 |
| | RD | 880 | ID | 1130 |
| | RE | 1080 | IE | 1490 |
| **1-1/16 to 1-1/4 inch** | | | | |
| | RF | 530 | IF | 670 |
| | RG | 640 | IG | 780 |
| | RH | 830 | IH | 1000 |
| | RI | 1140 | II | 1370 |
| | RJ | 1570 | IJ | 1950 |

## Remove First Piece

Begins with visually selecting cable-mounted connector to be removed.
Includes loosening and removing threaded collar and disengagement of cable-
mounted connector from fixed connector alone or in group. Ends with releasing
or laying aside cable-mounted connector.

## Install First Piece

Begins with reaching to cable-mounted connector alone or in group. Includes
reading cable number, visually selecting matching fixed connector, engaging
cable-mounted connector to fixed connector, starting and running down collar.
Ends with final tightening of threaded collar.

## Remarks

Does not include use of tools for final tightening or initial loosening of
threaded collar. Does not include installation or removal of safety wire.

Applies to AN 3100, AN 3106, and similar.

Case variable factor: distance 10%, weight 5%, control 85%.

(Identical to NALC code OTF-CE-XX).

|        | FIRST | TMU |
|--------|-------|-----|
|        | 01    | 573 |

## First Piece

Begins with measuring PCB eyelet spacing, obtaining component, positioning component to tool and forming leads. Ends with disengaging component from tool and asiding component and tool.
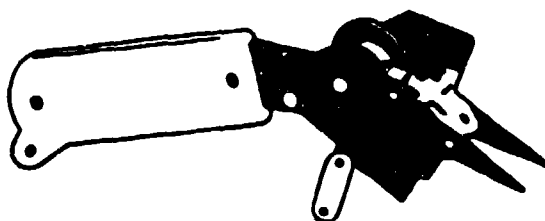
|         | REMOVE | TMU |
|---------|--------|-----|
|         | R1     | 116 |

**Remove First Piece**

Begins with reaching to PCB puller.  Includes positioning puller, actuating
puller, disengaging PCB, releasing puller.  Ends with asiding PCB and puller.

**Remarks**

Use OOH-PO-XX for Install.
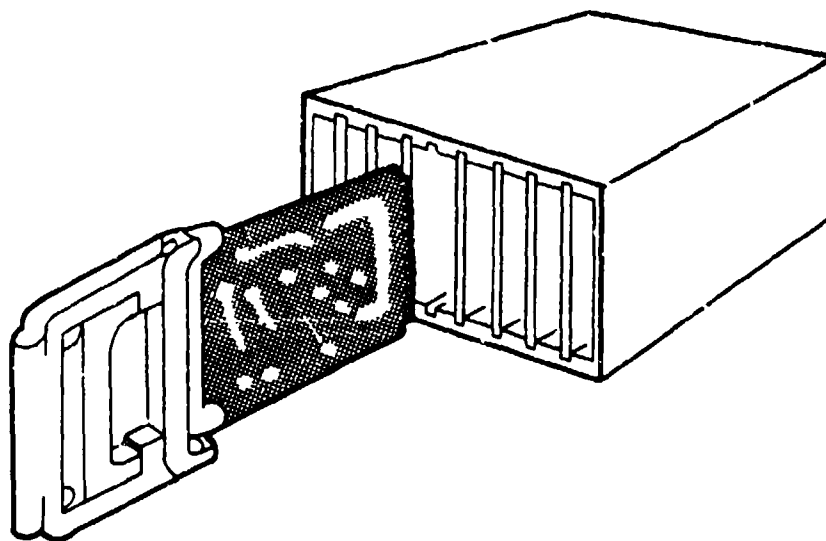
| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| R1     | 79  | I1      | 69  |

## Install

Begins with getting heat sink.  Includes opening heat sink and positioning on work object.

## Remove

Begins with reaching to heat sink.  Includes applying pressure to release heat sink.  Ends with asiding heat sink.
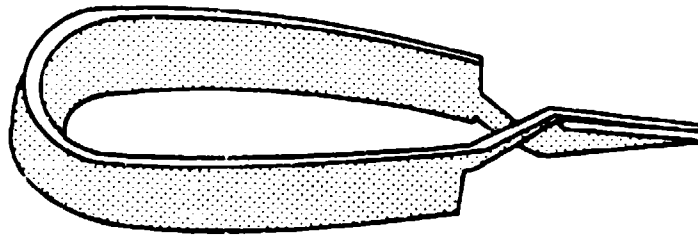
| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D1 | 2060 | Z1 | 830 |

## First

Begins with walking to printer.  Includes removing printout, installing a
probe on interface display unit, verifying first check point from printout,
locating check point on PCB, probing first test point with care.  Ends with
calling up test program by input to keyboard.

## Additional

Starts with verifying additional test point from printout.  Includes locating
point on PCB, and probing.


Remarks:   Use with EJP-TA-XX.

REMOVE

FIRST    TMU       ADDITIONAL    TMU

R1      1546          Y1        1496

## Desolder First

Begins with reaching to wicking braid.  Includes cutting, stripping, and forming curve in wicking braid, positioning wire to terminal, getting and cleaning soldering iron, positioning iron to terminal, wicking off excess solder.  Ends with asiding iron and wicking braid.

## Desolder Additional

Begins with cutting, stripping, and forming curve in wicking braid.  Includes positioning wire to terminal, getting and cleaning soldering iron, positioning iron to terminal, wicking off excess solder.  Ends with asiding iron.
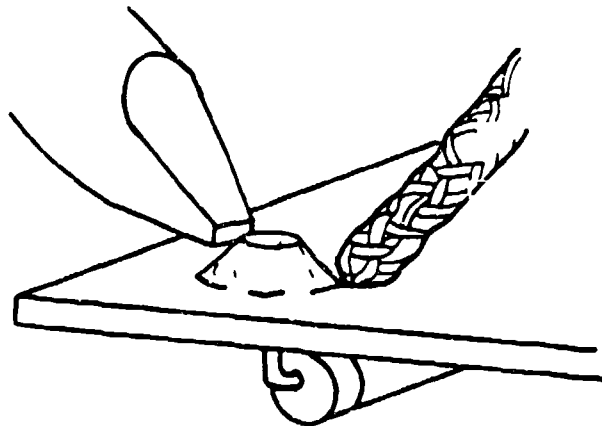
REMOVE

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| R2 | 633 | Y2 | 440 |

### Desolder First

Begins with reaching to desoldering pump.  Includes loading plunger, getting, cleaning, and positioning iron, positioning pump, heat pin, or terminal, actuating pump plunger.  Ends with asiding iron and pump.

### Desolder Additional

Begins with loading plunger.  Includes cleaning and positioning iron, positioning pump, heat pin, or terminal.  Ends with actuating pump plunger.
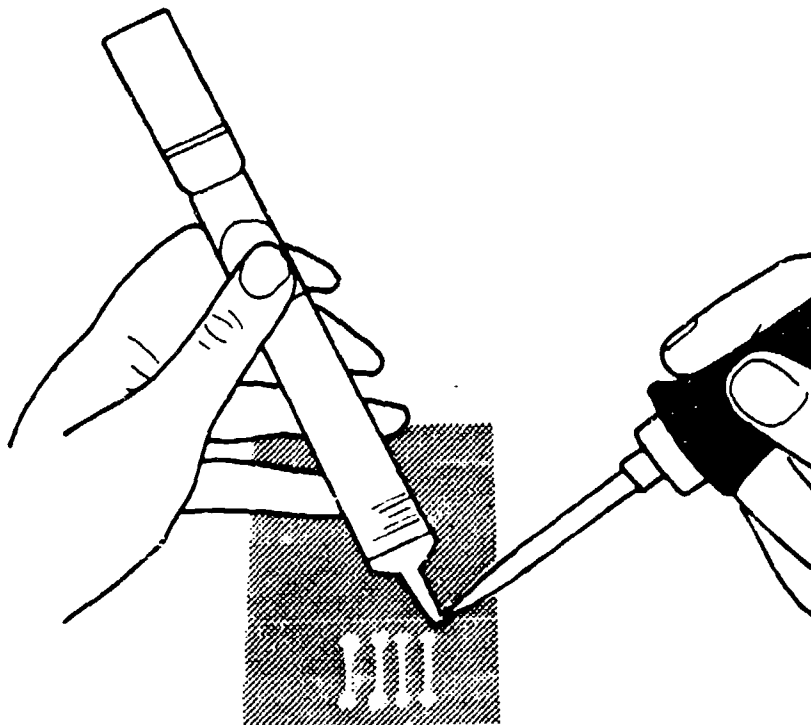
REMOVE

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| R3 | 522 | Y3 | 422 |

**Desolder First**

Begins with reaching to squeeze-bulb.  Includes getting iron, squeezing bulb, positioning iron and bulb, heating terminal, regrasping bulb.  Ends with asiding bulb and iron.

**Desolder Additional**

Begins with squeezing bulb.  Includes positioning iron and bulb, heating terminal.  Ends with regrasping bulb.
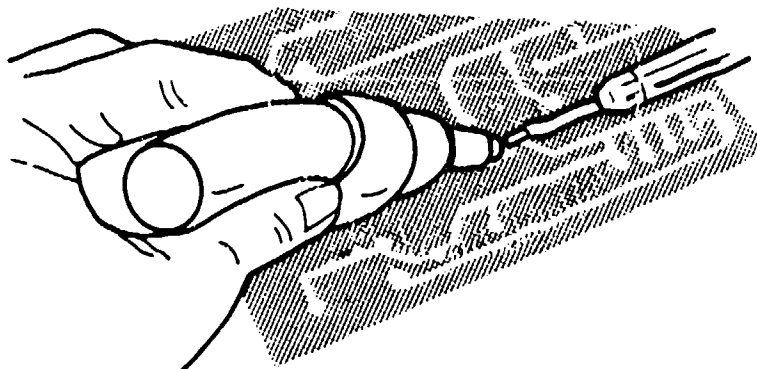
REMOVE

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| R4 | 230 | Y4 | 140 |

**Desolder First**

Begins with positioning printed circuit board. Includes getting desoldering tool, moving foot to foot pedal, desoldering tool to terminal, heating solder, actuating foot pedal. Ends with asiding iron and removing foot from foot pedal.

**Desolder Additional**

Begins with moving desoldering tool to terminal. Includes heating solder and actuating foot pedal. Ends with removing desoldering tool from terminal.
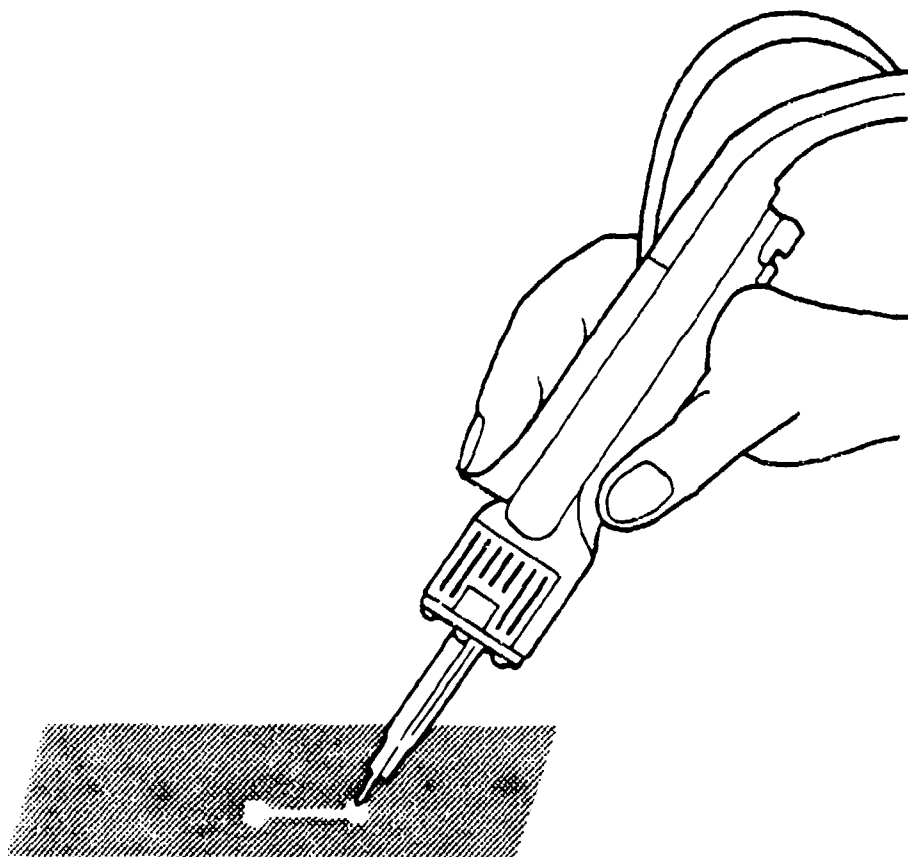
TIN

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| I1    | 595 | X1         | 482 |

## Tin First

Begins with reaching to soldering iron.  Includes cleaning tip, positioning
iron in holder, getting wire or solder, tinning wire or terminal.  Ends with
asiding wire or solder and soldering iron.

## Tin Additional

Begins with cleaning tip.  Includes getting wire or solder.  Ends with tinning
wire or terminal.
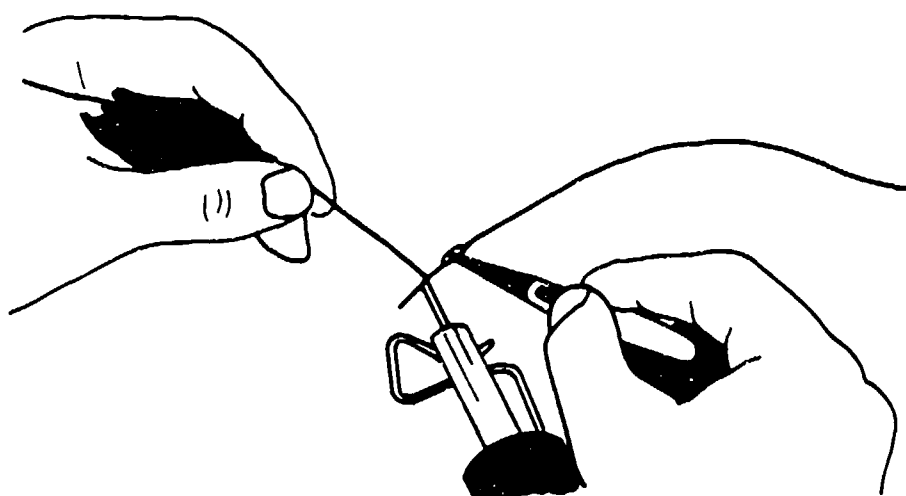
| UNSOLDER | | | | SOLDER | | | |
|---|---|---|---|---|---|---|---|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| R2 | 220 | Y2 | 142 | I2 | 513 | -- | -- |

**Unsolder First Piece**

Begins with reaching to iron.  Includes applying iron to terminal, unsoldering wire, disengaging wire, asiding wire.  Ends with asiding iron.

**Unsolder Additional Piece**

Begins with positioning iron to terminal.  Includes unsoldering wire, disengaging wire.  Ends with asiding wire.

**Solder First Piece**

Begins with reaching to wire.  Includes positioning wire to terminal, applying flux, getting solder and iron, cleaning iron, soldering wire to terminal, asiding iron and solder.  Ends with checking connection.
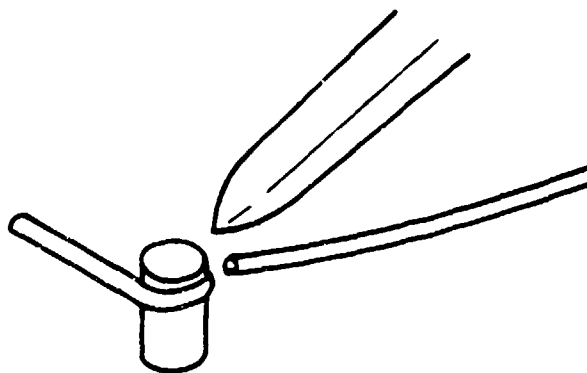
SOLDER

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| I3    | 306 | X3         | 166 |

## Solder First Lead

Begins with applying flux.  Includes getting solder and iron, cleaning iron, positioning solder and iron to lead, soldering lead, asiding iron and solder. Ends with checking connection.

## Solder Additional Leads

Begins with applying flux.  Includes cleaning iron, positioning iron and solder to lead, soldering lead.  Ends with checking connection.

|       | FIRST | TMU  |
|-------|-------|------|
|       | I4    | 3252 |

### First

Begins with getting wire.  Includes stripping wire, tinning wire, getting solder sleeve, positioning solder ring of sleeve over shielding, positioning jumper wire, getting Zap gun, plugging in Zap gun, adjusting Zap gun, positioning sleeve and wires in gun, actuating Zap gun, removing wire from gun, inspecting terminal, unplugging Zap gun.  Ends with asiding wire and gun.
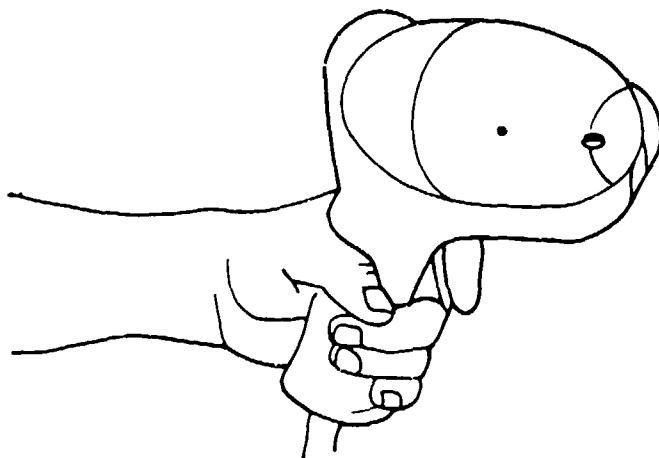
|  | REMOVE |  | INSTALL |  |
|---|---|---|---|---|
|  | FIRST | TMU | FIRST | TMU |
|  | R5 | 4762 | I5 | 2202 |

## Remove

Begins with preheating PCB (EJP-SE-01). Includes positioning board in holder, coating chip to be removed with temperature-indicating fluid, applying flux, positioning heat shield, turning on hot air terminal, extending hot air tubes, adjusting air flow, waiting for solder to melt, observing temperature-indicating material, disengaging chip.

## Install

(Follows removal before PCB has cooled)
Begins with getting new chip. Includes checking part number, positioning chip on board, applying flux, allowing time for solder to melt, observing solder that melts. Ends with turning off hot air terminal and removing PCB from holder.

## Remarks

Analysis based on use of Hart-100 hot air terminal, manufactured by Nu-Concept Computer Systems, Inc.
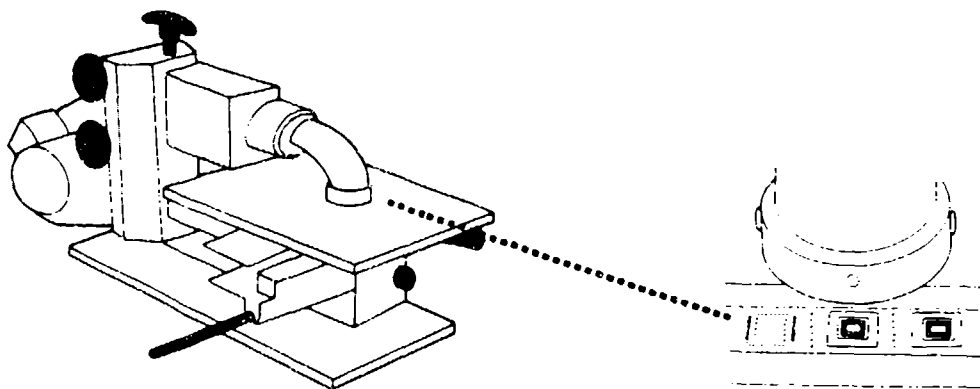
REMOVE AND INSTALL

| FIRST | TMU |
|-------|-----|
| 01    | 177 |

## Remove and Install

Begins with loosening chuck.  Includes removing bit or sleeve, asiding bit or sleeve, getting bit or sleeve, installing bit or sleeve.  Ends with tightening chuck.

## Remarks

Also applicable to other tools that do not use a chuck key.
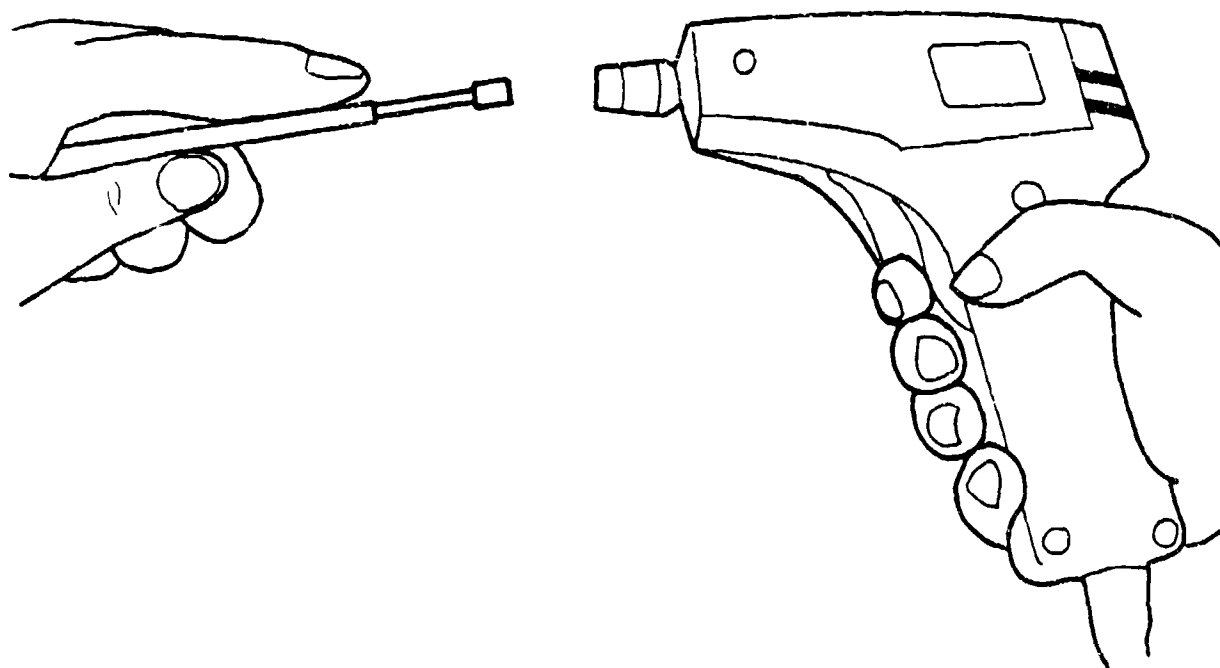
| REMOVE | | | | | INSTALL | | | |
|--------|-----|------------|-----|--|-------|------|------------|------|
| FIRST | TMU | ADDITIONAL | TMU | | FIRST | TMU | ADDITIONAL | TMU |
| RA | 150 | YA | 90 | | IA | 970 | XA | 140 |
| RB | 240 | YB | 130 | | IB | 1930 | XB | 330 |
| RC | 300 | YC | 160 | | IC | 2830 | XC | 450 |
| RD | 460 | YD | 210 | | ID | 5090 | XD | 800 |
| RE | 650 | YE | 280 | | IE | 8690 | XE | 1580 |

## Remove First Piece

Begins with reaching to diagonals or scissors. Includes cutting and removing cord. Ends with laying aside diagonals or scissors and cord.

## Remove Additional Piece

Begins with moving to additional lace point. Includes cutting cord. Ends with removing cord.

## Install First Piece

Begins with reaching to diagonals or scissors. Includes obtaining and cutting length of nylon ribbon or cord, tying wire bundle with clove hitch, additional loop and three lock stitches using tweezers or needlenose as necessary, and trimming cord end. Ends with laying aside diagonals or scissors.

## Install Additional Piece

Begins with moving to additional lace point. Ends with completing one lock stitch.

(Identical to NACL code OWH-BL-XX).

| REMOVE | | | | INSTALL | | | |
|--------|-----|------------|-----|-------|------|------------|-----|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| RA | 150 | YA | 90 | IA | 520 | -- | -- |
| RB | 240 | YB | 130 | IB | 890 | -- | -- |
| RC | 300 | YC | 160 | IC | 1390 | -- | -- |
| RD | 460 | YD | 210 | ID | 2340 | -- | -- |
| RE | 460 | YE | 280 | IE | 3800 | -- | -- |

## Remove First Piece

Begins with reaching to diagonals or scissors. Includes cutting and removing cord. Ends with laying aside diagonals or scissors and cord.

## Remove Additional Piece

Begins with moving to additional tie. Includes cutting cord. Ends with removing cord.

## Install First Piece

Begins with reaching to diagonals or scissors. Includes obtaining and cutting length of nylon ribbon or cord, tying wire bundle with clove hitch, additional loop using tweezers or needlenose as necessary, and trimming cord end. Ends with laying aside diagonals and scissors.

## Install Additional Piece

Not applicable.

(Identical to NALC code OWH-BT-XX).

## INSTALL

|          | FIRST | TMU  |
|----------|-------|------|
| Easy     | IB    | 854  |
| Moderate | IC    | 1324 |
| Difficult| ID    | 2314 |

### Remove

Use OTL-PD-XX.

### Install

Begins with reaching to strap.  Includes positioning strap around cable, getting cable-tying gun, positioning gun to strap, actuating gun.  Ends with asiding gun.

### Remarks

Case variable factors:  distance 0%, weight 0%, control 100%.
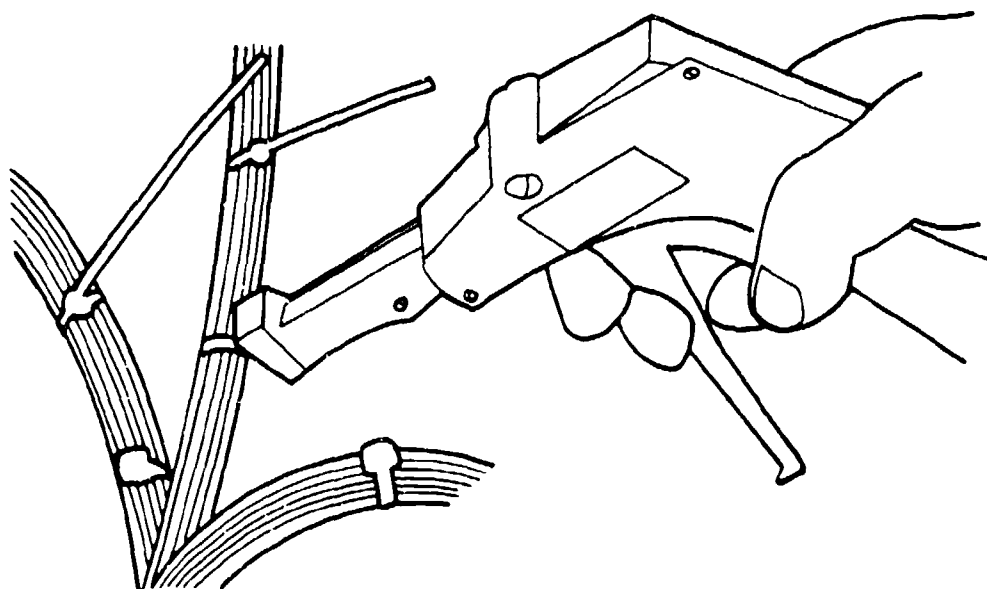
| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| D1 | 607 | Z1 | 487 |

## First Wire

Begins with reaching to wire.  Includes getting thermal stripper, positioning wire in stripper, actuating stripper, heating wire, disengaging wire from stripper, releasing stripper.  Ends with asiding stripper and wire.

## Additional Wire

Begins with reaching to wire.  Includes positioning wire in thermal stripper, actuating stripper, heating wire, disengaging wire from stripper, releasing stripper.  Ends with asiding wire.
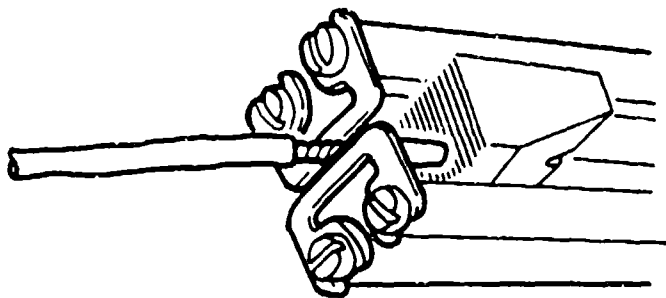


For nonthermal stripping use EWH-IS-XX.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01 | 260 | Z1 | -- |
| 02 | 410 | Z2 | 210 |
| 03 | 1110 | Z3 | 1020 |
| 04 | 1600 | Z3 | -- |
| 05 | 4800 | Z4 | -- |

## First Piece

Begins with reaching to wire(s) or cable. Includes obtaining tools, stripping shielding and/or insulation, and trimming loose threads. Ends with laying aside wire(s) or cable and tools.

## Additional Piece

Begins with reaching to additional wire. Includes striping insulation and trimming loose threads. Ends with asiding wire.

## Remarks

01 -- Nonshielded, single conductor, single wire. Sizes No. 22 to No. 8.
02 -- Nonshielded, single conductor, single wire of a group of loose wires. Sizes No. 22 to No. 8.
03 -- Shielded cables, center conductor. Sizes No. 22 to No. 8.
04 -- Coaxial cable. Sizes to 5/16-in. outside diameter.
05 -- Triaxial cable. Sizes to 3/8-in. outside diameter.

Applies to: Miller Adjustable Diagonal Stripper, Ideal Stripmaster, Pyramid E-Z Stripper. Knife cases 03, 04, and 05 apply only where accessibility is easy.

(Identical to NALC code OWH-IS-XX).

|  | INSTALL | TMU |
|--|---------|-----|
|  | I1 | 785 |

## Install

Begins with getting wire. Includes cutting wire, stripping insulation from
end of wire, asiding strippers, twisting strands of wire together, getting
pin, positioning wire in pin, verifying wire insertion into pin, getting
crimper, crimping pin to wire, releasing crimper, removing wire/pin. Ends
with asiding crimper and wire.
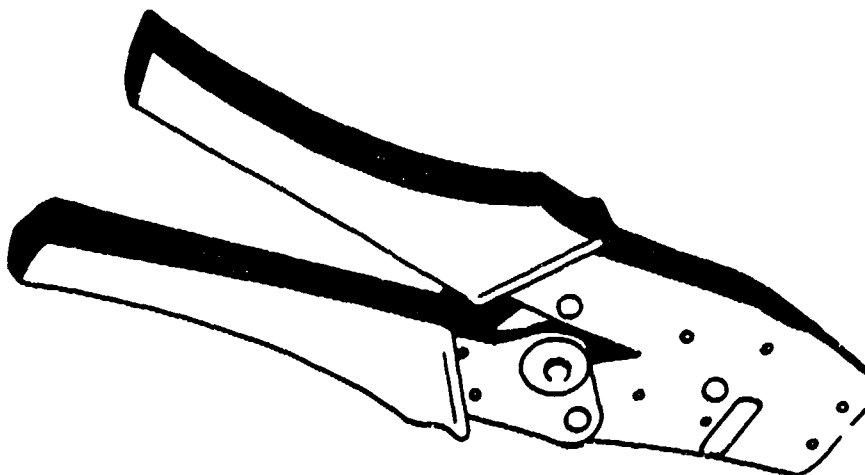
| REMOVE | | INSTALL | |
|---|---|---|---|
| FIRST | TMU | FIRST | TMU |
| R2 | 952 | I2 | 1290 |

**Remove Pin**

Begins with reaching to tool.  Includes checking wiring schematic, locating pin number in plug, positioning tool to pin, applying pressure to tool, disengaging pin from tool.  Ends with disengaging tool from plug.

**Install Pin**

Begins with reaching to tool.  Includes positioning pin to tool, checking wiring schematic, locating pin number in plug, positioning and inserting pin in plug, disengaging tool.  Ends with checking pin.
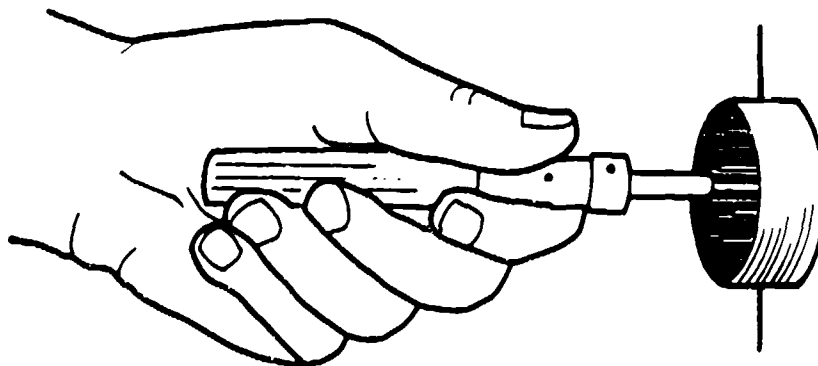
| REMOVE | | INSTALL | |
|---|---|---|---|
| -- | -- | I1 | 780 |
| -- | -- | I2 | 3080 |
| R3 | 990 | I3 | 4260 |
| R4 | 1430 | I4 | 7770 |
| R5 | 4520 | I5 | 14190 |

**Remove First Piece**

Begins with reaching to tool.  Includes cutting wire and/or unsoldering and disassembling terminator as necessary.  Ends with laying aside tools, wire or cable, and terminator.

**Install First Piece**

Begins with reaching to wire or cable.  Includes obtaining stripping tools, stripping insulation, obtaining and installing terminator by crimping, soldering, and assembling as necessary.  Ends with laying aside tools and wire or cable.

**Remarks**

I1 -- Lug or splices, No. 10 to No. 22 wire.
I2 -- Shielded cable connectors.
I3 and R3 -- Coaxial cable connectors, wedge-lock (small, single shielding).
I4 and R4 -- Coaxial cable connectors, wedge-lock (large, double shielding).
I5 and R5 -- Triaxial cable connectors, AMP 165-38-1001 or similar.

Does not include the use of special tools to strip coaxial or triaxial cables.

(Identical to NALC code OWH-TM-XX).

| REMOVE | | | | INSTALL | | | |
|--------|-----|------------|-----|-------|-----|------------|-----|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| R1 | 474 | Y1 | 436 | I1 | 543 | X1 | 492 |

## Remove First Piece

Begins with reaching to tool. Includes positioning tool to post, unwrapping wire, disengaging tool from post, disengaging wire from post. Ends with asiding wire and tool.

## Remove Additional Piece

Begins with positioning tool to post. Includes unwrapping wire, disengaging tool from post, disengaging wire from post. Ends with asiding wire.

## Install First Piece

Begins with reaching to tool. Includes getting wire, positioning wire in bit, positioning wire and tool to post, wrapping wire around post, disengaging tool. Ends with asiding of tool.

## Install Additional Piece

Begins with reaching to wire. Includes positioning wire in bit, positioning wire and tool to post, wrapping wire around post, disengaging tool.
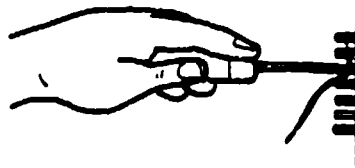


-1: Hand Twisted

| REMOVE | | | | INSTALL | | | |
|---|---|---|---|---|---|---|---|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| R2 | 117 | Y2 | 79 | I2 | 186 | X2 | 135 |

### Remove First Piece

Begins with reaching to hand-squeeze gun. Includes positioning gun to post, unwrapping wire, disengaging gun from post, disengaging wire from post. Ends with asiding wire and gun.

### Remove Additional Piece

Begins with positioning hand-squeeze gun to post. Includes unwrapping wire, disengaging gun from post, disengaging wire from post. Ends with asiding wire.

### Install First Piece

Begins with reaching to hand-squeeze gun. Includes getting wire, positioning wire in bit, positioning wire and gun to post, wrapping wire around post, disengaging gun. Ends with asiding gun.

### Install Additional Piece

Begins with reaching to wire. Includes positioning wire in bit, positioning wire and hand-squeeze gun to post, wrapping wire around post, disengaging.
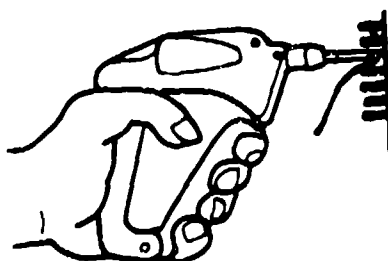


-2:  Hand-Squeeze Gun

For changing tool bit or sleeve, see ETP-WW-01

| REMOVE | | | | | INSTALL | | | |
|--------|-----|------------|-----|--|--------|-----|------------|-----|
| FIRST | TMU | ADDITIONAL | TMU | | FIRST | TMU | ADDITIONAL | TMU |
| R3 | 133 | Y3 | 95 | | I3 | 202 | X3 | 151 |

### Remove First Piece

Begins with reaching to power gun. Includes positioning gun to post, unwrapping wire, disengaging gun from post, disengaging wire from post. Ends with asiding wire and gun.

### Remove Additional Piece

Begins with positioning gun to post. Includes unwrapping wire, disengaging gun from post, disengaging wire from post. Ends with asiding wire.

### Install First Piece

Begins with reaching to powered wire wrap gun. Includes getting wire, positoning wire in bit, positioning wire and gun to post, wrapping wire around post, disengaging gun. Ends with asiding gun.

### Install Additional Piece

Begins with reaching to wire. Includes positioning wire to bit, positioning wire and gun to post, wrapping wire around post. Ends with disengaging gun.
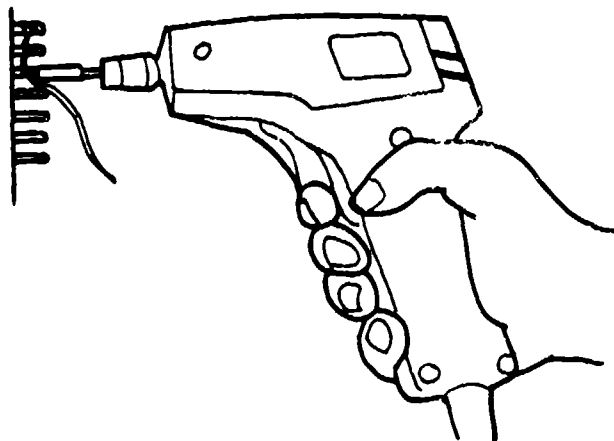


For wire wrap, hand, see EWH-WW-R1 and R2
For changing tool bit or sleeve, see ETP-WW-D1

| FIRST | TMU | | ADDITIONAL | TMU |
|---|---|---|---|---|
| 01 | 40 | | Z1 | 20 |
| 02 | 80 | . | Z2 | 40 |
| 03 | 170 | | Z3 | 140 |
| 04 | 470 | | Z4 | 450 |

## First Actuation

Begins with reaching to valve, switch, knob, or lever.  Includes actuating or adjusting to desired position.  Ends with obtaining a gauge or dial reading.

## Additional Actuation

Begins with hand on same valve or switch or knob or lever.  Ends with actuating or adjusting to additional desired position, and/or obtaining a gauge or dial reading.

## Remarks

01 -- Actuate single throw control or obtain instantaneous appearing reading.
02 -- Actuate control and obtain instantaneous appearing reading.
03 -- Actuate control and obtain momentarily appearing reading.
04 -- Actuate control and obtain delayed reading.

Momentarily appearing readings are defined as requiring coarse adjustments and/or stabilization with the required reading to an accuracy greater than $\pm$ 2.5% of a full-scale reading.

Delayed readings are defined as those requiring fine adjustments and/or stabilization with the required reading to an accuracy of $\pm$ 2.5% or less of a full-scale reading.

The terms coarse and fine are related to a complete operation, including start actuation, adjust, and obtain reading.

|  | UNFASTEN |  | FASTEN |  |
|---|---|---|---|---|
|  | FIRST | TMU | FIRST | TMU |
|  | R1 | 107 | I1 | 143 |

## Unfasten

Begins with reaching to tab. Includes turning tab to disengage, loosening latch and disengaging.

## Fasten

Begins with reaching to latch. Includes positioning latch in receptacle, turning tab to engage receptacle and tightening. Ends with releasing tab.
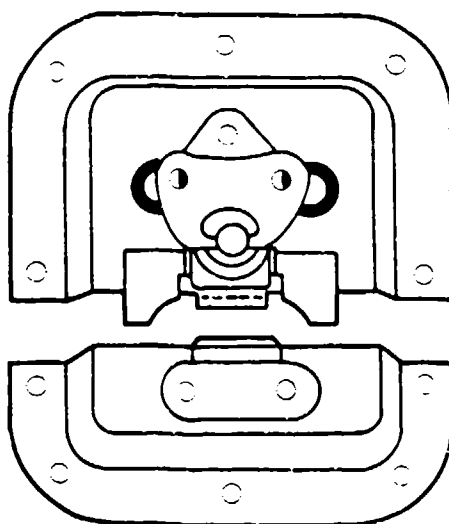
| | FIRST | TMU | ADDITIONAL | TMU |
|---|---|---|---|---|
| Climb Up or Down One Step | D1 | 72 | Z1 | 35 |
| Climb Up | D2 | 318 | -- | -- |
| Climb Down | D3 | 288 | -- | -- |

**First Step (D1)**

Begins with looking to ladder or stairs.  Grasp rail, place foot on rung, step up or down.  Ends with placing both feet on the same level.

**Additional Step (Z1)**

Begins by sliding hand along rail.  Step up or down, foot on rung.  Ends with eye traveling to next grasp point.

**Climb Up (D2)**

Begins with getting and asiding object 0 to 40 pounds.  Reach 40 inches height from floor to surface, raise leading foot, boost body with hands, apply pressure with foot and hands, turn body raise other foot.  Ends with arising.

**Climb Down (D3)**

Begins with squatting to sit.  Reach to surface, lower body with hands, lower leading leg, lower trailing leg apply pressure with hands, push off with hand, end with body standing on lower surface.  Ends with removing object.

| CASE | TMU |
|------|-----|
| 01   | 85  |
| 02   | 53  |
| 03   | 60  |

Case

01 -- Walk 10 ft in obstructed or unobstructed area with load of 5 to 50 lb.

02 -- Walk 10 ft in unobstructed area with load of 0 to 5 lb.

03 -- Walk 10 ft in obstructed area with load of 0 to 5 lb.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01 | 420 | Z1 | 130 |
| 02 | 1250 | Z2 | 400 |
| 03 | 2170 | Z3 | 620 |
| 04 | 3000 | Z4 | 880 |

**First Piece**

Begins with reaching to object to be cleaned. Includes selecting cloth, tampico brush, wire brush, scraper, or sandpaper, and removing contamination or corrosion from an area 12 in. by 12 in. by wiping, brushing, scraping, or sanding, dry or with solvent. Also includes blowing off with air and wiping. Ends with laying aside object and tools.

**Additional Piece**

Begins with repositionin' as necessary to gain access to area to be cleaned. Includes removing contami tion or corrosion from an area 12 in. by 12 in. by wiping, brushing, scraping, or sanding, dry or with solvent. Ends with blowing off and wiping.

**Remarks**

01 -- Light dust or small particles of dirt.
02 -- Light clinging dust and dirt or readily soluble oil or grease.
03 -- Heavy clinging dust and dirt, light stains, light corrosion, oil, or grease removable by mild scrubbing.
04 -- Heavy caked dust and dirt, heavy stains, heavy corrosion, hardened grease or preservatives, removable by extensive scraping, sanding, or brushing.

Simple surfaces are defined as readily accessible, requiring little or no repositioning during cleaning.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01 | 390 | Z1 | 230 |
| 02 | 520 | -- | -- |
| 03 | 360 | Z3 | 210 |
| 04 | 560 | Z4 | 310 |
| I4 | 460 | X4 | 220 |
| R4 | 110 | Y4 | 100 |
| 05 | 170 | Z5 | 90 |

## Install First Piece

Begins with reaching to tool and/or clamp. Includes obtaining and/or adjusting clamp as necessary, and installing on work. Ends with installing clamp or laying aside tool.

## Install Additional Piece

Begins with rea      to clamp. Includes obtaining and adjusting clamp as necessary, and installing on work. Ends with installing clamp.

## Remove First Piece

Begins with reaching to tool or clamp. Includes loosening clamp and removing from work. Ends with asiding tool and/or clamp.

## Remove Additional Piece

Begins with reaching to clamp. Includes loosening clamp and removing from work. Ends with asiding clamp.

## Remarks

01 -- Cleco, pliers type, install and remove.
02 -- Cleco, wing nut type, install and remove.
03 -- Toggle ("quickie") clamp or vise grip pliers, install and remove.
04 -- "C" Clamp, install and remove.
05 -- Spring clamp, install and remove.
I4 -- "C" Clamp install.
X4 -- "C" Clamp install, additional.
R4 -- "C" Clamp remove.
Y4 -- "C" Clamp remove, additional.

Limited to accomplishment containing some interference but wholly visible, or no interference and partially visible.

| CASE | TMU |
|------|-----|
| 01 | 10 |
| 02 | 100 |
| 03 | 1000 |
| 04 | 1000 |

Allowed time as determined by a qualified industrial engineering technician's estimate.

Remarks

Applies to manual operations where existing standard data elements do not properly describe motions performed.  Does not apply to process time.

| CASE | TMU |
|------|-------|
| 01 | 10 |
| 02 | 100 |
| 03 | 1000 |
| 04 | 10000 |

Allowed time derived from standard data of acceptable quality.

**Remarks**

Applies to manual motion sequences and/or machine or process time.

| CASE | TMU |
|------|-----|
| 01 | 10 |
| 02 | 100 |
| 03 | 1000 |
| 04 | 10000 |

Allowed time derived from repeating occurrence of a sequence of elements in the analysis of an operation.

Remarks

Applies to the repetition of any preceeding group of elements in the same time standard.

Should not be applied to the development of other elemental standard data.

Sources from which the allowed time is derived should be referenced at the point of OEL-RS-XX application.

(Adaptation of NALC code OEL-RS-XX).

| CASE | TMU |
|------|-----|
| 01 | 10 |
| 02 | 100 |
| 03 | 1000 |
| 04 | 10000 |

Allowed time as determined by stopwatch time study.

Remarks

Applies to manual operations where standard data elements do not properly describe the motions performed. Does not apply to process time.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| OA    | 120 | ZA         | 50  |
| OB    | 210 | ZB         | 100 |

## First Piece

Begins with reaching to object to be examined. Includes moving object to area of vision, selecting light or magnifying glass if required and examining one focal area (4-in. dia at 16 in. from eye). Ends with laying aside object and light or glass.

## Additional Piece

Begins with repositioning of object as necessary to examine next focal area. Ends with examining focal area.

## Remarks

OA -- Cursory examination permitting rapid decision (e.g., NC or NF threads to 2-in. dia or 1/2 in. of threads 2-in. to 4-in. dia; simple surface for condition of paint, plating, etc).

OB -- Close examination of particular detail (e.g., special or close tolerance threads to 2-in. dia or 1/2 in. of threads 2-in. to 4-in. dia; irregular surfaces for condition of plate or plating, surfaces that are machined, bearing, mating, etc). Applies to yes or no evaluation not requiring prolonged mental consideration. Use when no other operations are being performed or where examination is the limiting factor.

|                                              | CASE | TMU |
|----------------------------------------------|------|-----|
| Open hinged panel, engage hold-open rod      | D1   | 490 |
| Close hinged panel, stow hold-open rod       | D2   | 490 |

## Open

Begins at hinged panel that has been unfastened.  Includes opening panel, disengaging hold-open rod, and ends with positioning hold-open rod to hold panel open.

## Close

Begins at a hinged panel that is held by a hold-open rod.  Includes disengaging and stowing hold-open rod, ends with closing panel.

## Remarks

D1 and D2 derived from Boeing code 530101.

| CASE | TMU |
|------|------|
| 01 | 330 |
| 02 | 650 |
| 03 | 1210 |
| 04 | 180 |
| 05 | 160 |
| 06 | 280 |
| 07 | 380 |
| 08 | 480 |
| 09 | 730 |

## Uncoil

Begins with coiled cord in hand. Includes paying out cord while walking and untangling cord as necessary. Ends with plug in hand.

## Coil

Begins with reaching to end of unattached cord. Includes coiling cord for storage.

## Remarks

01 -- Coil and uncoil 10-ft cord.
02 -- Coil and uncoil 25-ft cord.
03 -- Coil and uncoil 50-ft cord.
04 -- Coil 10-ft cord.
05 -- Uncoil 10-ft cord.
06 -- Coil 25-ft cord.
07 -- Uncoil 25-ft cord.
08 -- Coil 50-ft cord.
09 -- Uncoil 50-ft cord.

|        | REMOVE |        | INSTALL |        |
|--------|--------|--------|---------|--------|
|        | FIRST  | TMU    | FIRST   | TMU    |
|        | R1     | 90     | I1      | 96     |

## Remove

Begins with getting capped part.  Includes reaching to cap, applying pressure
to cap, disengaging cap.  Ends with asiding cap.

## Install

Begins with getting protective cap.  Includes getting part to be capped,
positioning cap.  Ends with applying pressure to complete cap installation.

|  FIRST | TMU |
|--------|------|
| 01 | 590 |
| 02 | 79C |
| 03 | 640 |
| 04 | 760 |
| 05 | 1370 |

## Manually Actuated Time Recording Clock

Begins at time clock. Includes selecting in-process and planned work cards from rack, recording time on each card and job order number (pencil entry) on planned work card. Ends with replacing both cards in rack.

## Transactor

Begins at transactor. Includes selecting identity card and transaction card(s), placing cards in transactor, setting one or more dials, and recording transaction. Ends with replacing cards in rack.

## Remarks

Manually actuated time recording clock

01 -- Work content as stated above.
02 -- Work content as stated above except clock is at Sched-U-Man dock and
      includes selecting Sched-U-Man card from rack, recording time on card
      and replacing card in rack.

Transactor Actuated Recording

03 -- One transaction card and one dial setting.
04 -- One transaction card and one to seven dial settings.
05 -- Two transaction cards and one to seven dial settings.

| CASE | TMU |
|------|-----|
| 01 | 110 |
| 02 | 130 |
| 03 | 80 |
| 04 | 40 |
| 05 | 80 |
| 06 | 50 |

## Plug In

Begins with reaching to plug. Includes connecting to outlet or receptacle. Ends with plug in place.

## Disconnect

Begins with reaching to plug. Includes removing plug from outlet or receptacle. Ends with plug in hand.

## Remarks

01 -- Standard two- or three-prong plug.
02 -- Twist lock plug.
03 -- Plug in (standard).
04 -- Unplug (standard).
05 -- Plug in (twist).
06 -- Unplug (twist).

|                 | CASE | TMU |
|-----------------|------|-----|
| Open and Close  | 01   | 77  |
| Open            | 02   | 44  |
| Close           | 03   | 33  |

## Open

Begins with reaching to the drawer.  Includes releasing drawer latch or lock.
Ends with the drawer open and locked in position.

## Close

Begins with reaching to the drawer.  Ends with the drawer closed and latched.

## Remarks

Drawer with or without thumb latch or similar.

(Similar to NALC code MJP-DR-XX)

| FASTEN | TMU | UNFASTEN | TMU |
|--------|-----|----------|-----|
| I1 | 1330 | R1 | 370 |

### Fasten

Begins with reaching to rope or cord. Includes positioning first end of rope
to object, tying a knot, positioning the second end of the rope. Ends with
tying a knot in the second end.

### Unfasten

Begins with reach to knot. Includes untying two knots. Ends with asiding
rope or cord.

| CASE | TMU |
|------|-----|
| 01 | 490 |
| 02 | 260 |

## Put On

Begins with reaching to glass case or goggles. Includes removing glasses from case and cleaning glasses or goggles as necessary. Ends with glasses or goggles in place.

## Remove

Begins with reaching to glasses or goggles. Includes removing and inserting in case. Ends with asiding glasses case or goggles.

## Remarks

01 -- Safety glasses.
02 -- Safety goggles.

| INSTALL | TMU | REMOVE | TMU |
|---------|-----|--------|-----|
| 01 | 393 | -- | -- |

## Install

Begins with selecting dril. bit, rotating chuck by hand open or close, inserting bit into chuck, tightening chuck by hand, getting and inserting chuck key, and tightening chuck.  Ends with disengaging and asiding key.

## Remove

(Use OOH-DE-OC for removing bit.)

|                      | CASE | TMU  |
|----------------------|------|------|
| Microscope           | D1   | 1671 |
| Eyeglass             | D2   | 108  |
| Loupe                | D3   | 125  |
| Illuminated Magnifier| D4   | 500  |
| Clean Lens           | D5   | 91   |

**Set Up Microscope (D1)**

Begins with reaching to microscope. Includes positioning scope, plugging in and turning on light, all motions necessary to adjust height or length of plane and adjust focal setting, adjust eye width, select power. Ends with working piece in focus and asiding after use.

**Position Eyeglass Mounted Loupe Down and Up (D2)**

Begins with reaching to loupe. Includes positioning loupe down, reaching to loupe. Ends with loupe up.

**Position Hand-Held Loupe To or From Eye (D3)**

Begins with reaching to loupe. Includes positioning loupe to eye, reaching to loupe. Ends with asiding loupe.

**Illuminated Magnifier (D4)**

Begins with positioning magnifier to work area. Includes turning on light and repositioning magnifier. Ends with turning off light and asiding magnifier.

**Clean Loupe Lens (D5)**

Begins with reaching to cleaning tissue. Clean lens. Ends with asiding tissue.
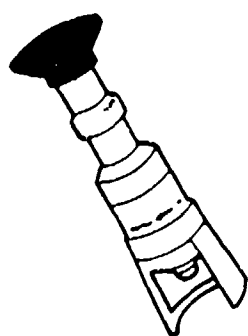
| INSTALL | TMU | REMOVE | TMU |
|---------|-----|--------|-----|
| I1 | 21820 | R1 | 11882 |

## Install (Donning previously fitted ensemble)

Begins with donning protective suit pants. Includes removing ensemble from
ensemble storage container, unzipping, zipping, unsnapping, snapping pants
fasteners. Continues with donning protective footware, protective gloves,
protective coat and mask carrier, removing mask and hood from carrier,
positioning mask on face and head, checking mask for leaks. Ends with
poitioning and fastening straps and cords, and closing hood and mask carrier.

## Remove (Doffing uncontaminated ensemble)

Begins with doffing mask and hood by disengaging underarm straps, loosening
neck cord, positioning cape over head and removing mask and hood. Includes
cleaning moisture from hood and mask, positioning hood and mask in carrier.
Continues with doffing mask carrier and protective coat, doffing protective
gloves, footwear, and protective suitpants. Ends with packing protective
clothing in storage container.

## Remarks

Ensemble has been fitted previously. Hood is attached to mask and both are
stored in the carrier. It is installed over normal items of clothing when
contamination is imminent.
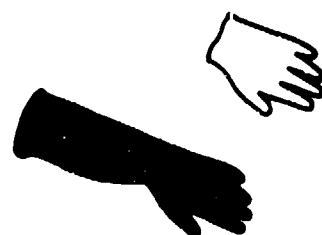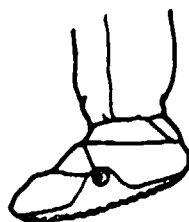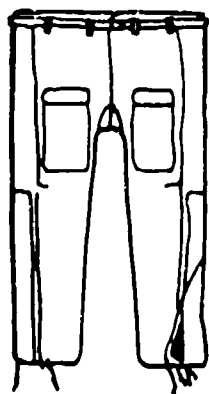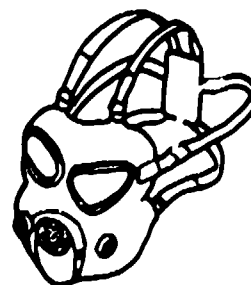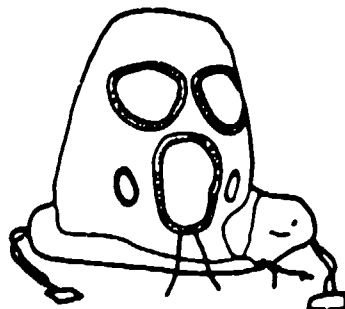
| INSTALL | TMU | REMOVE | TMU |
|---------|-----|--------|-----|
| I1 | 4040 | R1 | 1220 |

## Install

Begins with getting safety harness. Includes untangling harness, positioning shoulder straps, hooking shoulder straps, fastening belt, positioning and hooking leg straps. Ends with adjusting all straps.

## Remove

Begins with unhooking leg straps. Includes unhooking belt, shoulder straps, and folding safety harness. E.ds with asiding harness.

FIRST     TMU

OA     50
OB     120
OC     190
OD     270
OE     350

## First Piece

Begins with reaching to object. Includes picking up and minimally controlled moving to an approximate location. Ends with releasing object.

## Remarks

OA -- Move to 18 in. and weight to 3 lb.
OB -- Move to 30 in. and weight to 10 lb.
OC -- Move to 4 ft including stooping if necessary and weight to 20 lb.
OD -- Move to 6 ft including stooping if necessary and weight to 30 lb.
OE -- Move to 8 ft including stooping if necessary and weight to 50 lb.

If unusual control is required, use OOH-PO.

Case variable factors: distance 80%, weight 20%

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01    | 210 | Z1         | 110 |

## First Piece

Begins with reaching to drawer. Includes opening unlocked drawer, searching and selecting to locate alphabetically or numerically filed identity, or positioning and removing from or replacing in drawer. Ends with laying aside identity and/or closing drawer.

## Additional Piece

Begins with reaching to filed material in bin or drawer. Includes searching and selecting to locate alphabetically or numerically filed identity, or positioning and removing from or replacing in bin or drawer. Ends with identity in hand or in file.

## Remarks

Filed material must be clearly identified so that only a minor separation of pieces is required to verify selection.

| | FIRST | TMU | ADDITIONAL | TMU |
|---|---|---|---|---|
| Bin or shelf | | | | |
| | 01 | 60 | Z1 | 60 |
| | 02 | 100 | Z2 | 70 |
| Drawer or cabinet | | | | |
| | 03 | 160 | Z3 | 60 |
| | 04 | 200 | Z4 | 70 |

## Bin or Shelf

01 -- Single or handful or obvious part(s) lying alone or jumbled with like parts.

02 -- Single indistinguishable part among or jumbled with dissimilar parts.

### First Piece

Begins at bin or shelf. Includes reaching, selecting, and picking up desired object(s) to 20 lb. Ends with laying aside object(s).

### Additional Piece

Begins with placing first part on other hand. Ends with selecting and picking up desired object.

## Drawer or Cabinet

03 -- Single or handful of obvious part(s) lying alone or jumbled with like parts.

04 -- Single indistinguishable part among or jumbled with dissimilar parts.

### First Piece

Begins at drawer or cabinet. Includes reaching to doors or drawer, opening unlocked doors or drawer, selecting and picking up desired object(s) to 20 lb, and closing doors or drawer. Ends with laying aside object(s).

### Additional Piece

Begins with placing first part on other hand. Ends with selecting and picking up desired object.

|          | FIRST | TMU | ADDITIONAL | TMU |
|----------|-------|-----|------------|-----|
| Unfasten | RA    | 110 | YA         | 60  |
| Unfasten | RB    | 160 | YB         | 80  |
| Fasten   | IA    | 140 | XA         | 90  |
| Fasten   | IB    | 200 | XB         | 130 |

## Unfasten First Piece

Begins with reaching to tool. Includes positioning tool to fastener stud and twisting to unfasten stud from receptacle. Ends with laying aside tool.

## Unfasten Additional Piece

Begins with moving to fastener stud with tool. Includes positioning tool to stud and twisting to unfasten. Ends with unfastening stud from receptacle.

## Fasten First Piece

Begins with reaching to tool. Includes positioning tool to fastener stud and twisting stud to secure in receptacle. Ends with laying aside tool.

## Fasten Additional Piece

Begins with moving to fastener stud with tool. Includes positioning tool to stud and twisting to secure. Ends with fastening stud to receptacle.

## Remarks

Applies to DZUS, CAMLOC, AIRLOCK and similar fasteners.

Case variable factors: distance 10%, weight 5%, control 85%.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| O1 | 50 | Z1 | 40 |

## Unfasten or Fasten First Piece

Begins with reaching to latch trigger plate. Includes placing finger or thumb to trigger plate and applying pressure to release latching plate.  Ends with releasing pressure.

## Unfasten or Fasten Additional Piece

Begins with reaching to latch trigger plate. Includes placing finger or thumb to trigger plate and applying pressure to release latching plate. Ends with releasing pressure.

## Remarks

Applies to pressure-type trigger latches.
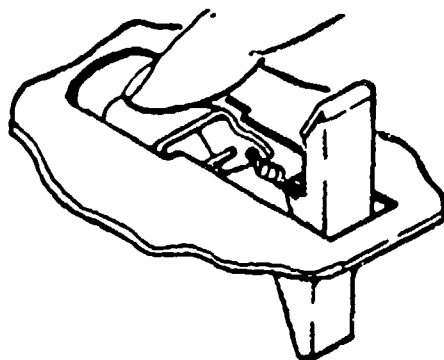
| REMOVE | | | | INSTALL | | | |
|--------|-----|------------|-----|-------|-----|------------|-----|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| RA | 180 | YA | 150 | IA | 210 | XA | 170 |
| RB | 320 | YB | 25C | | | | |

## Remove First Piece

Begins with reaching to Tru-Arc pliers. Includes inserting pliers in ring and removing ring from internal or external groove. Ends with laying aside tool and ring.

## Remove Additional Piece

Begins with reaching to ring with pliers. Includes inserting pliers in ring and removing ring from internal or external groove. Ends with palming or laying aside ring.

## Install First Piece

Begins with reaching to ring. Includes selecting Tru-Arc pliers, inserting in ring, and installing ring in internal or external groove. Ends with laying aside tool.

## Install Additional Piece

Begins with reaching to ring. Includes inserting pliers in ring and installing ring in internal or external groove. Ends with releasing ring.

## Remarks

Supplement with positions (OOH-PO) and disengages (OOH-DE) for higher cases.

Case variable factors: distance 10%, weight 5%, control 85%.

| REMOVE | | | | INSTALL | | | |
|---|---|---|---|---|---|---|---|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| RA | 300 | YA | 60 | IA | 650 | XA | 80 |

## Remove First Piece

Begins with reaching to diagonals. Includes cutting wire between two anchor points and removing. Ends with laying aside wire and tools.

## Remove Additional Piece

Begins with cutting wire to additional anchor point. Ends with removing wire.

## Install First Piece

Begins with reaching to supply of wire. Includes selecting pliers and diagonals, cutting wire to length, inserting in first anchor point, inserting in second anchor point to 3-in. distance, returning to first anchor point, twisting to secure, and cutting and tucking end. Ends with laying aside tools.

## Install Additional Piece

Begins with inserting wire in additional point. Ends with pulling wire tight.

## Remarks

Supplement with positions (OOH-PO) and disengages (OOH-DE) for higher cases.

Case variable factors: distance 10%, weight 5%, control 85%.

| REMOVE | | | | INSTALL | | | |
|--------|-----|------------|-----|-------|-----|------------|-----|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| RA | 71 | YA | 63 | IA | 52 | XA | 48 |

### Remove First Piece

Begins with reaching to scribe or awl. Includes inserting awl in ring and removing ring with pliers from internal or external groove. Ends with laying aside tools and ring.

### Remove Additional Piece

Begins with reaching to ring with awl. Includes inserting tool in ring and removing ring from internal or external groove. Ends with palming or laying aside ring.

### Install First Piece

Begins with reaching to ring. Includes selecting tool and installing ring in internal or external groove. Ends with laying aside tool.

### Install Additional Piece

Begins with reaching to ring. Includes installing ring in internal or external groove. Ends with releasing ring.

### Remarks

Maximum depth of snap ring is 1 in. Maximum diameter of snap ring is 4 in.

Supplement with positions (OOH-PO) and disengages (OOH-DE) for higher cases.

Case variable factors: distance 10%, weight 5%, control 85%.

| REMOVE | | | | INSTALL | | | |
|--------|-----|-----------|-----|--------|------|------------|------|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| RA | 410 | YA | 170 | IA | 870 | XA | 320 |
| RB | 950 | YB | 270 | IB | 1420 | XB | 600 |
| RC | 2080 | YC | 580 | IC | 2750 | XC | 920 |
| RD | 4080 | YD | 1170 | ID | 4460 | XD | 1290 |
| RE | 7420 | YE | 2080 | IE | 6670 | XE | 1750 |

## Remove First Piece

Begins with reaching to diagonals.  Includes cutting wire at two anchor points
and removing.  Ends with laying aside wire and tools.

## Remove Additional Piece

Begins with cutting wire at additional anchor point.  Ends with removing wire.

## Install First Piece

Begins with reaching to supply of wire.  Includes selecting pliers and
diagonals, cutting wire to length, inserting in first anchor point, twisting to
second anchor point to 3-in. distance, inserting in second anchor point,
twisting to secure, and cutting and tucking end.  Ends with laying aside tools.

## Install Additional Piece

Begins with twisting wire to additional anchor point to 3-in. distance.  Ends
with insertion in additional anchor point.

## Remarks

Case variable factors: distance 10%, weight 5%, control 85%.

For removal use one first
and two additional

For removal use one first
and one additional
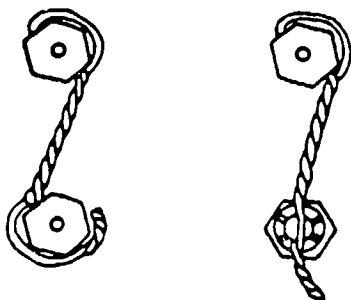
For installation use two first

For installation use one first
and one additional

| | CASE | TMU |
|---|---|---|
| Get up to four light objects | D1 | 480 |
| Aside up to four light objects | D2 | 480 |
| Get and aside up to four light objects | D3 | 960 |
| Get one medium to heavy object | D4 | 400 |
| Aside one medium to heavy object | D5 | 400 |
| Get and aside one medium heavy object | D6 | 800 |
| Final position or aside small work stand | D7 | 510 |
| Position or aside small work stand | D8 | 1140 |

**Get**

Begins by reaching and picking up object(s). Includes carrying object(s) up to 15 ft. Ends with asiding object(s) in hand.

**Aside**

Begins with object(s) in hand. Includes carrying object(s) up to 15 ft. Ends with asiding object(s).

**Get and Aside**

Begins with reaching and picking up object(s). Includes carrying object(s) up to 30 ft. Ends with asiding object(s).

**Final Positioning or Asiding Work Stand**

Begins by grasping small work stand. Includes moving work stand to desired work location or from work position to clear area. Distance allowance of 20 ft is included for getting to or from work stand and moving it.

**Position or Aside Small Work Stand**

Begins by getting control of small work stand. Includes moving stand up to 90 ft or walking up to 45 ft to stand and moving stand 45 ft. Ends with stand in position for work or in storage area.

**Remarks**

D1, D2, D3 derived from Boeing code 81A003.
D4, D5, D6 derived from Boeing code 81A004.
D7        derived from Boeing code 81A005.
D8        derived from Boeing code 81A025.

| DISENGAGE | TMU |
|-----------|-----|
| OA | 70 |
| OB | 120 |
| OC | 220 |
| OD | 400 |
| OE | 700 |

## Disengage

Begins with reaching to object or tool. Includes obtaining control of object with hand(s), or with tool when tool is an extension of the hand(s), and loosening and extracting or removing one object from another. Ends with laying aside tool and/or object.

## Remarks

Tools included are a putty knife, screw driver, pliers, or similar to overcome the limitations of hand or finger dexterity or access. Strength may be used with slight to considerable effort. Use of hammer is not included.

Case variable factors: distance 45%, weight 10%, control 45%.

| POSITION | TMU |
|----------|------|
| 0A | 120 |
| 0B | 250 |
| 0C | 420 |
| 0D | 830 |
| 0E | 1670 |

## Position

Begins with reaching to part or other object. Includes relating one part or object to another by aligning, orienting, and engaging. Ends with objects in desired relationship.

## Remarks

Does not include fastening or securing operations. Does not include extremely precise or minute operations requiring high skill. Includes minimal use of tools.

Case variable factors: distance 10%, weight 5%, control 85%.

| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| R1 | 300 | I1 | 460 |
| -- | -- | I2 | 4520 |

**Remove**

Begins with reaching to routing tag. Includes untying bow knot or untwisting wire and removing tag from point of attachment. Ends with laying aside tag.

**Install (I1)**

Begins with reaching to routing tag. Includes inserting wire or string through point of attachment and tying string in bow knot or twisting wire. Ends with tag secured to point of attachment.

**Install (I2)**

Fill out and attach tag begins with obtaining tag and pen. Includes positioning tag for writing, filling in required information, obtaining information from other material or part name plate, certifying work or condition. Ends with inserting card or tag in an envelope and attaching it to the part.

| FIRST | TMU |
|-------|-----|
| 01 | 210 |
| 02 | 380 |
| 03 | 290 |
| 04 | 460 |

## Open Can

Begins with reaching to can. Includes unscrewing cap by hand, selecting tool to remove metal seal as required, and piercing and removing seal. Ends with laying aside seal and/or can.

## Close Can

Begins with reach to cap. Includes placing cap to can and tightening with hand pressure. Ends with cap in place.

## Remarks

01 -- Screw cap can, one thread, without seal to 1-gal capacity.
02 -- Screw cap can, one thread, with metal seal to 1-gal capacity.
03 -- Screw cap can, one thread, without seal, 1-gal to 5-gal capacity.
04 -- Screw cap can, one thread, with metal seal, 1-gal to 5-gal capacity.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01    | 260 | Z1         | 70  |

## First Piece

Begins with reaching to envelope. Includes reading nomenclature to verify content, tearing envelope with care to avoid damage to contents, and extracting a single object. Ends with laying aside object and envelope.

## Additional Piece

Begins with reaching to open envelope. I   des extracting additional single object. Ends with laying aside object.

| UNPACK | TMU | PACK | TMU |
|--------|-----|------|-----|
| R1 | 487 | I1 | 405 |
| R2 | 1680 | I2 | 1213 |
| R3 | 1542 | I3 | 2119 |
| R4 | 881 | I4 | ---- |
| R5 | 790 | I5 | 800 |
| R6 | 1170 | I6 | 1050 |
| R7 | 163 | I7 | 207 |
| | | I8 | 4022 |

## Unpack

Begins with reaching to envelope, package, box, or bag. Open by tearing, cutting, unfolding or unlatching, removing packing as necessary, removing object. Ends with laying aside object, packing, envelope, package, box, or bag.

R1 -- Envelope or adhesive sealed package, hand tear or cut open.

R2 -- Cardboard box, flaps cemented or stapled, 0 to 8-ft perimeter of opening.

R3 -- Cardboard box flaps taped, 0 to 8-ft perimeter of opening.

R4 -- Plastic dipped or coated or "bubble" pack, up to 15 in.$^2$

R5 -- Reusable box, no latches, lid fits loose.

R6 -- Reusable box, 2 latches, lid fits loose.

R7 -- Remove object from static-shielding bag.

## Pack

Begins with reach to envelope, package, box, or bag. Open the same by spreading apart, unfolding flaps, removing lid, or unlatching lid, removing packing if necessary, positioning object, positioning package, sealing edges, folding flaps, installing lid or latching. End with asiding envelope, package, box, or bag.

I1 -- Place object in envelope or package and seal.

I2 -- Place object in box, fold flaps, cement or staple closed.

I3 -- Place object in box, fold flaps, seal with tape.

I4 -- (Not a normal maintenance operation).

I5 -- Place object in box, install lid.

I6 -- Place object in box, position lid and latch.

I7 -- Place object in static-shielding bag, close bag.

I8 -- Place object in vacuum-desiccated package.

| CASE | TMU |
|------|-------|
| 01 | 10 |
| 02 | 100 |
| 03 | 1000 |
| 04 | 10000 |

Process time, related to manual or machine operations, as determined by a qualified Industrial Engineering Technician estimate.  Begins with the cessation of manual motion, includes all operator idle time, and ends with the resumption of manual motions.

## Remarks

Use only when no other operations are performed or where process time is the limiting factor.

| CASE | TMU |
|------|-----|
| 01 | 10 |
| 02 | 100 |
| 03 | 1000 |
| 04 | 10000 |

Process time, related to manual or machine operations, as required by authorized technical directive.  Begins with the cessation of manual motions, includes all operator idle time, and ends with the resumption of manual motions.

Remarks

Use only when no other operations may be performed or where process time is in the limiting factor.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|------|------------|------|
| D1 | 3922 | Z1 | 2572 |
| D2 | 380 | Z2 | 50 |

## First (D1)

Begins with getting technical data. Includes locating page number desired from index, turning to page, reading text, and observing sketch or photograph. Ends with asiding data.

## Additional (Z1)

Begins with data page located. Includes reading text and observing sketch or photograph.

## First (D2)

Begins with getting Form 781 (or equivalent). Includes locating desired write up, reading ten words and assimilating information. Ends with asiding Form 781.

## Addition (Z2)

Begins with desired page located. Includes reading and assimilating an additional ten words.

## Remarks

D1 and Z1 are for a typical page of maintenance instructions with an average of 330 words.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01 | 520 | Z1 | 70 |
| 02 | 550 | Z2 | 110 |
| 03 | 1260 | Z3 | 780 |

## First

Begins with reach to aerosol spray can. Includes removing cap or cover, shaking can to agitate vehicle, positioning can for use, actuating button to coat a spot or area, inverting can, actuating button to blow vehicle from tube, and replacing cap or cover. Ends with asiding can.

## Additional

Begins with can in hand. Includes positioning to additional spot or area as necessary, actuating button to coat surface, and in process vehicle agitation as necessary. Ends with can in hand.

## Remarks

01 -- Spot (bolt head, rivet, nut or area to 2 in.$^2$)

02 -- Strip, linear 1 by 12 in.

03 -- Area, surface, 1 ft$^2$


Applies to unobstructed surface treatment with primer, rust inhibitor, dri-lube, lacquer, or similar. Does not include time for agitation of new issue or equivalent condition aerosol cans.

| REMOVE | TMU  | INSTALL | TMU  |
|--------|------|---------|------|
| RA     | 170  | IA      | 220  |
| RB     | 420  | IB      | 470  |
| RC     | 590  | IC      | 640  |
| RD     | 1000 | ID      | 1050 |
| RE     | 1840 | IE      | 1890 |

## Remove First Piece

Begins with reaching to bolt, screw, or nut. Includes initial loosening, running off a maximum of 10 turns, and removing from stud or threaded hole. Ends with laying aside washer and bolt, screw, or nut.

## Install First Piece

Begins with reaching to bolt, screw, or nut. Includes selecting washer, installing to stud or threaded hole, and running down a maximum of 10 threads. Ends with tightening motion.

## Remarks

Applies to NF (National Fine) or NC (National Coarse) screw threads, #2 to 1/2-in. diameter.

| REMOVE | | | | INSTALL | | | |
|--------|-----|------------|-----|-------|-----|------------|-----|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |

No. 2 to 1/2 in.

| | | | | | | | |
|------|------|----|------|----|------|----|------|
| RA | 710 | YA | 460 | IA | 840 | XA | 580 |
| RB | 1100 | YB | 850 | IB | 1220 | XB | 970 |
| RC | 1630 | YC | 1370 | IC | 1730 | XC | 1450 |
| RD | 2240 | YD | 1970 | ID | 2360 | XD | 2050 |
| RE | 2940 | YE | 2630 | IE | 3060 | XE | 2730 |

9/16 to 1 in.

| | | | | | | | |
|------|------|----|------|----|------|----|------|
| RF | 1270 | YF | 950 | IF | 1500 | XF | 1210 |
| RG | 1710 | YG | 1310 | IG | 1920 | XG | 1550 |
| RH | 2310 | YH | 1910 | IH | 2570 | XH | 2170 |
| RI | 3020 | YI | 2600 | II | 3240 | XI | 2770 |
| RJ | 4080 | YJ | 3710 | IJ | 4240 | XJ | 3720 |

### Remove First Piece

Begins with reaching to tools. Includes loosening and removing nut and washer(s) from screw or bolt and removing screw or bolt. Ends with laying aside parts and tools.

### Remove Additional Piece

Begins with moving to nut with tools. Includes loosening and removing nut and washer(s) from screw or bolt and removing screw or bolt. Ends with laying aside parts.

### Install First Piece

Begins with reaching to screw or bolt. Includes inserting screw or bolt in hole, installing of washer(s) and nut on screw or bolt, selecting tools, and tightening, but not torquing, nut. Ends with laying aside tools.

### Install Additional Piece

Begins with reaching to screw or bolt. Includes inserting screw or bolt in hole and installing washer(s) and nut on screw or bolt. Ends with tightening, but not torquing.

### Remarks

Note 1: Includes alignment of castellated nut to cotter pin hole.
Note 2: To allow for extra thread length, add an add'l piece, next-easiest case.
Note 3: First piece includes attaching socket and attaching extension (50% OCC.)
Note 4: Add an extra aside if bolts or screws are to be moved.

Case variable factors: distance 10%, weight 5%, control 85%.

| REMOVE | | | | INSTALL | | | |
|--------|------|------------|------|-------|------|------------|------|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| R1 | 600 | Y1 | 280 | I1 | 72 | X1 | 42 |
| R2 | 1130 | Y2 | 520 | | | | |

**Remove First Piece**

Begins with reaching to tools. Includes loosening and removing nut and washers from bolt and removing bolt from hole. Ends with laying aside parts and tools.

**Remove Additional Piece**

Begins with moving to bolt with tools. Includes loosening and removing nut and washers from bolt and removing bolt from hole. Ends with laying aside parts.

**Install First Piece**

Begins with reaching to bolt. Includes inserting bolt in hole, installing washers and nut on bolt, selecting tools, and tightening but not separately torquing. Ends with laying aside tools.

**Install Additional Piece**

Begins with reaching to bolt. Includes inserting bolt in hole and installing washers and nut on bolt. Ends with tightening but not separately torquing.

**Remarks**

Includes impact wrench to 1/2-in. drive on bolts to 1/2-in. dia and Keller air wrench on bolts to 5/16-in. dia.

Includes torquing where tool contains fixed or adjustable slip clutch.

Note: R2 and Y2 apply to bolts that require the use of hand tools to break torque prior to removal with power tools.

| REMOVE | TMU | INSTALL | TMU |
|--------|-----|---------|-----|
| RA | 120 | IA | 140 |
| RB | 240 | IB | 260 |
| RC | 370 | IC | 390 |
| RD | 540 | ID | 560 |
| RE | 950 | IE | 970 |

**Remove First Piece**

Begins with reaching to cap or plug and part. Includes initial loosening, running off a maximum of five turns, and removing cap or plug. Ends with laying aside cap or plug.

**Install First Piece**

Begins with reaching to cap or plug. Includes selecting hose, tube, or part, installing cap or plug, and running down a maximum of five turns. Ends with tightening motion.

**Remarks**

Applies to all aluminum or plastic caps and plugs conforming to specification MIL-C-5501B, Type I, II, and III.

| UNFASTEN | | | | FASTEN | | | |
|---|---|---|---|---|---|---|---|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| RA | 400 | YA | 320 | IA | 440 | XA | 370 |

**Unfasten First Piece**

Begins with reaching to tool. Includes placing tool to fastener stud and turning to unfasten stud from receptacle. Ends with laying aside tool.

**Unfasten Additional Piece**

Begins with placing tool to fastener stud. Includes turning to unfasten. Ends with unfastening stud from receptacle.

**Fasten First Piece**

Begins with reaching to tool. Includes placing tool to fastener stud and turning stud to secure in receptacle. Ends with laying aside tool.

**Fasten Additional Piece**

Begins with placing tool to fastener stud. Includes turning to secure. Ends with stud fastened to receptacle.

**Remarks**

Applies to CAMLOC Series 4S stud and receptacle assemblies.

| UNFASTEN | | | | FASTEN | | | |
|---|---|---|---|---|---|---|---|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |

No. 2 to 1/2 inch dia.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RA | 610 | YA | 430 | IA | 680 | XA | 500 |
| RB | 1000 | YB | 820 | IB | 1060 | XB | 860 |
| RC | 1430 | YC | 1210 | IC | 1570 | XC | 1350 |
| RD | 1920 | YD | 1600 | ID | 2180 | XD | 1970 |
| RE | 2380 | YE | 2010 | IE | 2810 | XE | 2580 |

9/16 to 1 inch dia.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RF | 1090 | YF | 890 | IF | 1220 | XF | 1050 |
| RG | 1260 | YG | 1070 | IG | 1390 | XG | 1200 |
| RH | 1930 | YH | 1680 | IH | 2240 | XH | 2030 |
| RI | 2490 | YI | 2110 | II | 2890 | XI | 2660 |
| RJ | 3210 | YJ | 2830 | IJ | 3810 | XH | 3510 |

Remove First Piece

Begins with reaching to tool(s). Includes loosening and removing screw or nut from hole or stud and removing washer from screw or stud. Ends with laying aside parts and tool(s).

Remove Additional Piece

Begins with moving to screw or nut with tool(s). Includes loosening and removing screw or nut from hole or stud and removing washer from screw or stud. Ends with laying aside parts.

Install First Piece

Begins with reaching to screw or nut. Includes installing washer on screw or stud, installing screw or nut to hole or stud, selecting tool(s), and tightening, but not torquing. Ends with laying aside tool(s).

Install Additional Piece

Begins with reaching to screw or nut. Includes installing washer on screw or stud and installing screw or nut to hole or stud. Ends with tightening, but not torquing.

Remarks

Does not include the use of power wrench.

Applies to NF and NC machine screws and nuts.

To allow for extra long thread length use additional piece next lower case.

Case variable factors: distance 10%, weight 5%, control 85%.

| REMOVE | | | | INSTALL | | | |
|--------|------|------------|------|--------|------|------------|------|
| FIRST | TMU | ADDITIONAL | TMU | FIRST | TMU | ADDITIONAL | TMU |
| R1 | 430 | Y1 | 210 | I1 | 460 | Z1 | 270 |
| R2 | 710 | Y2 | 450 | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- | -- |
| R5 | 1920 | Y5 | 1520 | -- | -- | -- | -- |

## Remove First Piece

Begins with reaching to tool(s). Includes loosening and removing screw or nut from hole or stud and removing washer from screw or stud. Ends with laying aside parts and tool(s).

## Remove Additional Piece

Begins with moving to screw or nut with tool(s). Includes loosening and removing screw or nut from hole or stud and removing washer from screw or stud. Ends with laying aside parts.

## Install First Piece

Begins with reaching to screw or nut. Includes installing washer on screw or stud, installing screw or nut to hole or stud, selecting tool(s) and tightening, second torquing if clutching type tool. Ends with laying aside tool(s).

## Install Additional Piece

Begins with reaching to screw or nut. Includes installing washer on screw or stud, and installing screw or nut to hole or stud. Ends with tightening and torquing if clutching type tool.

## Remarks

Includes impact wrench to 1/2-in. drive on screws to 1/2-in. dia: Keller air wrench on screws to 5/16-in. dia.

Note: R2 and Y2 apply to screws or nuts to 3/8-in. dia that require the use of hand tools to break torque prior to removal with power tools.

R5 and Y5 apply to the use of a rivet gun and ratchet (persuader) to remove frozen Phillips or Reed Prince screws.

(X3 and X4 have been omitted to retain consistency with NALC codes.)

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01 | 16 | Z1 | 12 |
| 02 | 29 | Z2 | 25 |

**First Piece**

Begins with reaching to cutting pliers.  Includes obtaining wire, string or cord, placing pliers to cutting point, and cutting.  Ends with laying aside pliers and wire, string, or cord.

**Additional Piece**

Begins with moving to additional cutting point.  Ends with cutting wire, string, or cord.

**Remarks**

01 -- Approximate cutting point.
02 -- Exact cutting point.

Applies to soft iron wire to .040, stainless safety wire to .040, copper wire to .10-in. dia or similar.

| CASE | TMU |
|------|-----|
| 01 | 530 |
| 02 | 190 |
| 03 | 300 |
| 04 | 230 |

## In and Out

Begins with reaching to vise. Includes opening vise, obtaining object, and positioning within and closing vise, tightening handle, reaching to vise handle, opening vise, obtaining object.  Ends with laying object aside.

## Remarks

01 -- Work content as above with dimension to be clamped not in excess of 2 in. and weight not in excess of 20 lb.
02 -- Repositioning of above object.
03 -- Object in vise.
04 -- Object out of vise.

| FIRST | TMU | ADDITIONAL | TMU |
|-------|-----|------------|-----|
| 01 | 770 | Z1 | 140 |
| 02 | 480 | Z2 | 200 |

## First Piece

Begins with reaching to torque wrench. Includes obtaining and attaching socket
and extension or adapter, adjusting torque setting if necessary, placing wrench
on bolt or nut and tightening to specified torque.  Ends with laying aside
tools.

## Additional Piece

Begins with placing wrench on bolt or nut. Ends with tightening to specified
torque.

## Remarks

01 -- Ratchet or nonratchet snap over torque wrench to 1600 in.-lb.
02 -- Spring or dial type torque wrench to 1600 in.-lb.
Z1 -- Used for supplement to OTF-BM/SM (etc.) for second (or more) times(s)
around.  Also, use 02 to tighten/loosen.

Note: Use OOH-PO-XX for accessibility (one case lower than the SM/BM) since
special extensions are often used to overcome an access problem.

| CASE | TMU |
|------|-----|
| 01 | 80 |
| 02 | 180 |
| 03 | 300 |
| 04 | 470 |

Begins with eye traveling to source data. Includes reading numeric data and writing duplicate entry on form or other document. Ends with completing entry.

## Remarks

Includes writing data retained in memory such as shop number, date, or process code. Source data must be readily available without search and select such as page location or similar.  Includes selection of data within a group or desired line in a listing provided format of source data is familiar to the user.

01 -- 1 to 3 digits.
02 -- 4 to 8 digits.
03 -- 9 to 13 digits.
04 -- 14 to 20 digits.

| PER WORD | TMU |
|----------|-----|
| 01 | 120 |

Begins with eye traveling to source data. Includes reading prose data and writing duplicate entry on form or other document. Ends with completing entry.

**Remarks**

Includes writing data retained in memory such as part name or shop title. Source data must be readily available without search and select such as page location or similar. Includes selection of data within a group or desired line in a listing provided format of source data is familiar to the user.

(Identical to NALC code OWR-WT-XX).

## 7.3 Standard Environments

Some maintenance actions involve walking considerable distances to and from the areas in which work is performed. Several standard work environments have therefore been included to provide the analyst with uniform assumptions on the nature of the real world. The assumptions enable maintenance time predictions to be made for design studies involving life-cycle costing and selection of equipment. In addition, such studies can be readily changed into work measurement standards by comparison of the standard work area with the actual work area. Figures 7.3-1, 7.3-2, and 7.3-3 show standard layouts for avionic and shipboard organizational level maintenance. Figure 7.3-4 shows the layout of a repair shop appropriate for both intermediate and depot level analysis.
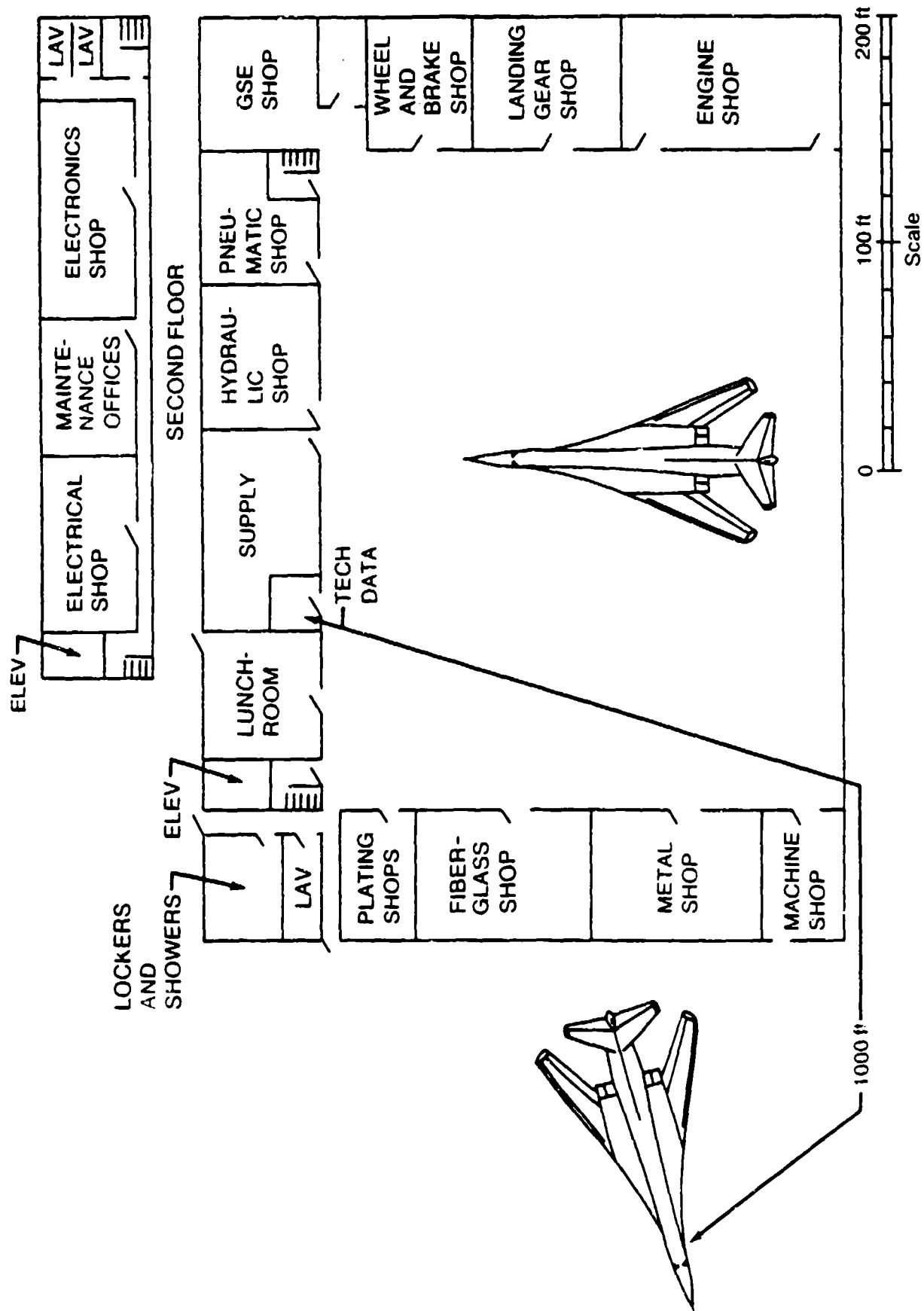
Figure 7.3-1. Standard Hanger and Flight Line Layout

AVIONICS SHOP

ET SHACK

WATERTIGHT
DOORS

**Aircraft Carrier:**
Equivalent walking distance to or
from shipboard electronics = 500 ft
and to or from avionics = 200 ft

WATERTIGHT
DOORS

**Cruiser:**
Equivalent walking distance
to or from any job = 200 ft

ET SHACK

WATERTIGHT
DOOR

ET SHACK

**Destroyer:**
Equivalent walking distance
to or from any job = 100 ft
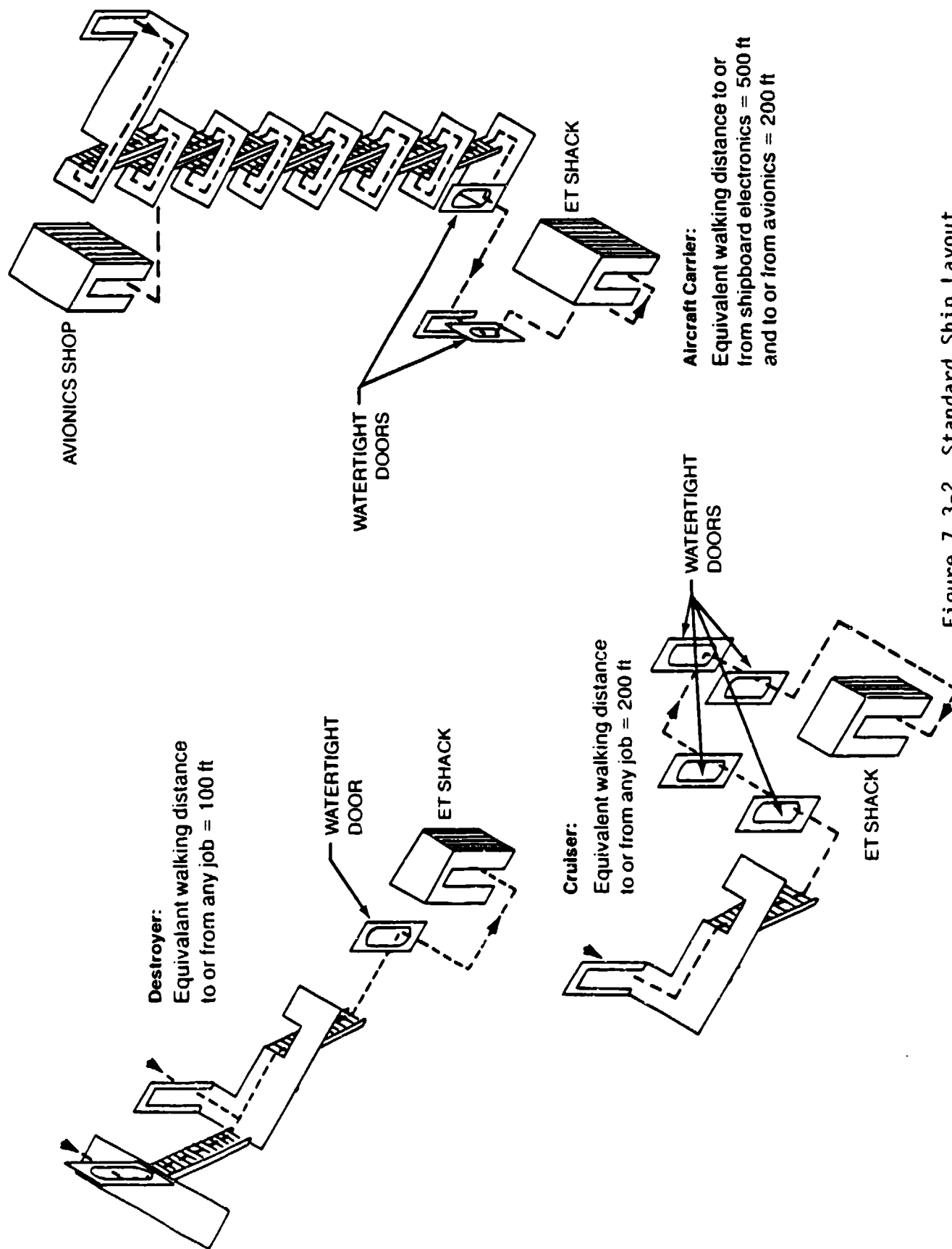
Figure 7.3-2. Standard Ship Layout
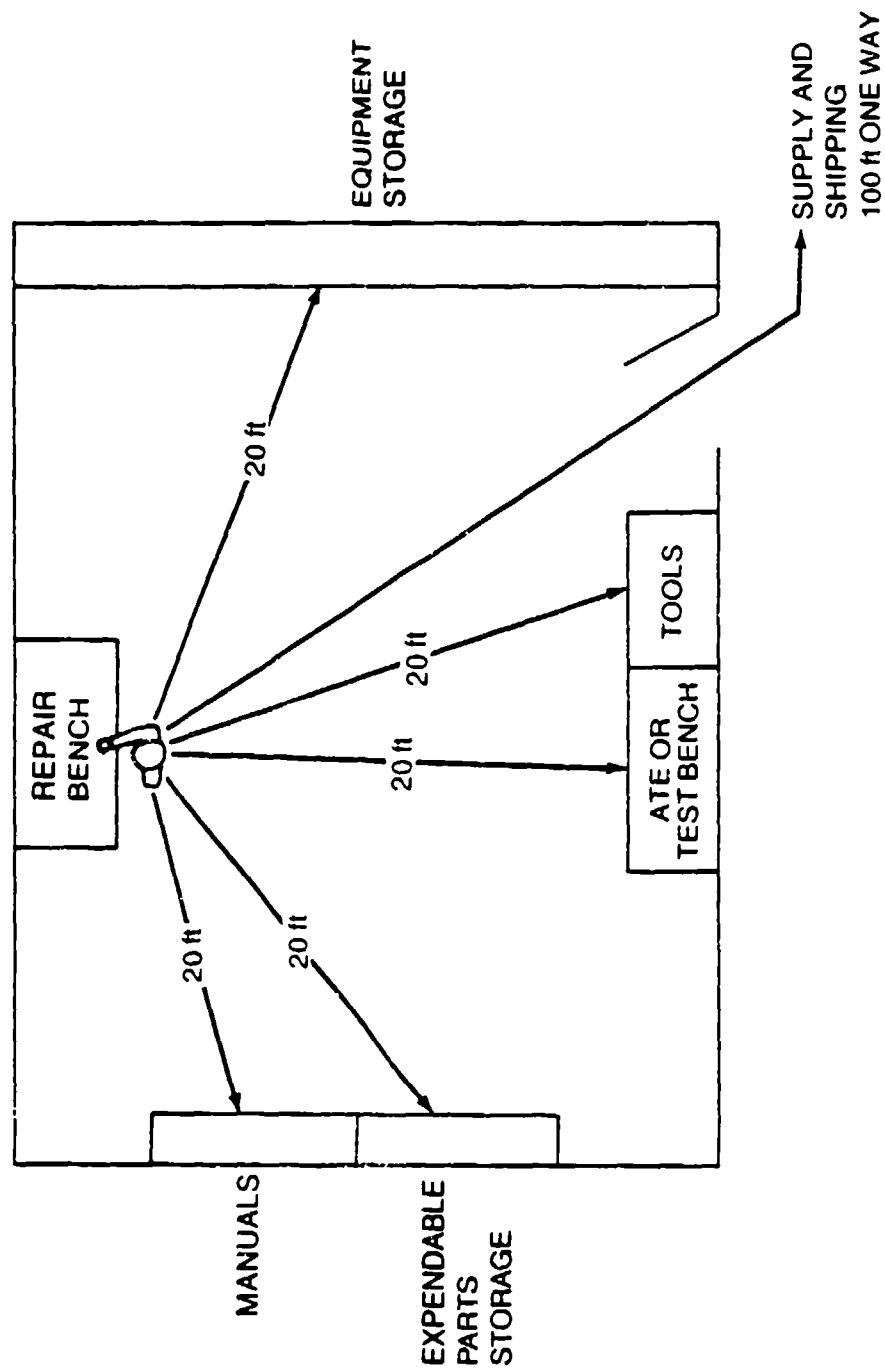
Figure 7.3-3. Repair Shop

# 8.0 REFERENCES

1-1     MIL-STD-1567A
        Work Measurement
        AFSC/PMD, Directorate of Manufacturing, Andrews AFB, DC 20334

3-1     Pliska, T.F., Jew, F.L. and Angus, J.E.,
        Maintainability Prediction and Analysis Study,
        RADC-TR-78-169, July 1978

3-2     DuBlanica, W., Kubeck, J. and Edwards, E.,
        Validation of Maintainability Prediction,
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3-3     Williams, R.L., Allegri, T.H., Bayha, F.T., et. al.,
        ANSI Standard for Work Measurement and Methods
        ANSI Z94.12 American Society of Mechanical Engineers, July 1972

3-4     Maynard, H.B.,
        Industrial Engineering Handbook,
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3-5     Karger, D.W. and Bayha, F.H.,
        Engineered Work Measurements,
        Industrial Press Inc., 1966

3-6     DOD 5010.15.1-M
        Standardization of Work Measurement
        Volume VII Bench Work Occupations
        DOD/DIRSO, February 1977

3-7     DOD 5010.15.1-M
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        DOD/DIRSO, February 1977

5-1     Appendix II DOD 5010.15.1-M, Basic Volume,
        DOD/DIRSO, February 1977

5-2     Introduction to Work Study, Revised Edition
        International Labor Office, Geneva 1969

5-3     Transfer Functions and Learning Curves,
        D.R. Towill, Ergonomics 1976, Vol. 19, No. 5 623-638

5-4     Managerial Control Systems Based On Learning Curve Models,
        D.R. Towill and F.W. Bevis, Int. J. Prod. Res.,
        1972, Vol. II, No. 3

5-5     SAC Supplement to AFR 355-1, June 10, 1983

6-1     Human Performance and Productivity,
        Vol. 3, p 237-247, E.A. Alliuisi and E.A. Fleishman,
        Lawrence Erlbaum Associates, 1982

# APPENDIX A

## Index of Examples

| Description | Level | Task Code |
|---|---|---|
| Conduct Flight Line Test to Isolate Troubles in UHF Radio System | Organizational | 152314XM01 |
| Remove and Install UHF Receiver-Transmitter | Orgzanizational | 112314XM01 |
| Bench Test UHF AN/ARC-109 System Using Radio Test Set AN/ARM-113 at an Intermediate Level | Intermediate | 552314XM01 |
| Fault Isolate a UHF Transceiver Confirmed to be Inoperative in Both Receive and Trasmit Modes | Depot | 552314XM02 |
| Remove and Install Module, Power Supply 1A8 | Depot | 112314XM02 |
| Troubleshoot UHF Transceiver Power Supply (1A8) That Has a Faulty 26.5 VDC Output | Depot | 552314XM03 |
| Remove and Install Capacitor C8 | Depot | 112314XM03 |
| Minimum Performance Test of UHF Power Supply Module 1A8 | Depot | 502314XM01 |
| Perform Minimum Performance Test on UHF Radio Receiver Transmitter | Depot | 502314XM02 |
| Job Preparation-Check for Presence of Electrical Energy and Correct Continuity or Opens Prior to Connection to Missle Ordnance and Arming and Disarming Circuits | Intermediate | 81ALCMST01 |

Appendix A provides examples of the use of the elemental standard data of Section 7.0. to analyze the repair of electronic equipment. The examples are for the F-15 airplane UHF radio and an AGM 86 missile. The examples

A1

were selected because of the ready availability of technical manuals and test instructions. To demonstrate the use of the standard data at all levels of electronic maintenance, studies of the F-15 UHF radio system were made based on the following sequence of events:

1. An F-15 returns from a mission with a UHF radio inoperative. An AN/ARM-113 test set is used to troubleshoot the system at an organizational level. (Task Code: 152314XM01)

2. Organizational-level maintenance personnel remove and replace the UHF transceiver (T/R). (Task Code: 112314XM01)

3. The intermediate-level maintenance shop personnel bench test the T/R unit. Tests confirm that the UHF will neither transmit nor receive and the unit is shipped back to the depot. (Task Code: 552314XM01)

4. Troubleshooting at the depot reveals the main transmitter-receiver has a defective power supply module (1A8). (Task Code: 552314XM02)

5. The power supply module (1A8) is removed for troubleshooting and repair by the depot. (Task Code: 112314XM02, Step A)

6. The power supply module (1A8) is bench tested per maintenance manual troubleshooting procedure at the depot. A defective capacitor (C8) is found. (Task Code: 552314XM03)

7. The defective capacitor (C8) is removed and replaced by a depot level technician. (Task Code: 112314XM03)

8. A minimum performance test is conducted by the depot on the power supply module (1A8). (Task Code: 502314XM01)

9. The power supply module is replaced in the T/R unit by the depot. (Task Code: 112314XM02, Step B)

10. A minimum performance test is conducted on the T/R unit. (Task Code: 502314XM02)

Up to the time at which troubleshooting of modules takes place (event 4 above) the maintenance actions are independent of failure mode. In the example scenario, event 4 reveals a problem with the power supply module, 1A8. For event 4 through 9, the analyses cover work on power supply module only.

Other failure modes of the UHF radio could be analyzed in a similar manner. An analysis of all failure modes would provide sufficient information to determine the Mean Time to Repair (MTTR) for the UHF radio system using the method of calculation provided in Reference 3-1. The failure rates for each failure mode of all modules and parts are, of course, required to complete the calculation of MTTR.

In addition to the studies made of the UHF on the F-15, a study was made of the Safe Test of the AGM86 missile, in which a check is made for presence of electrical energy and correct continuity or opens prior to connection of missile ordnance, arming, and disarming circuits.

TASK CODE: 152314XM01
==========

PART NAME: UHF RADIO SYSTEM

SUMMARY
-------

APL MODEL: F-15          PART NO:                          ZONE:

TASK DESCRIPTION:   *   CONDUCT FLT LINE TEST TO
                    *   ISOLATE TROUBLES IN UHF RADIO
                    *   SYSTEM

PREPARED BY: J.DAVOLT        ORG: B7463      DATE: 1-9-84P

REQUESTED BY: J.ROSE         ORG: B7463      REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:   THIS ANALYSIS IS FOR USE AS AN EXAMPLE OF
           MAINTAINABILITY TIME STANDARDS APPLICATION. THE
           UHF RADIO AN/ARI09 IS INSTALLED ON F-15 AIRCRAFT.
           USING THE TEST SET AN/ARM-113 AT THE APL IS
           OPTIONAL TO REMOVING THE TRANSCEIVER, CONTROLLER
           OK INTERCOM SET AND PERFORMING THE TESTS ON A
           BENCH SETUP. IN THIS ANALYSIS IT IS ASSUMED ACCESS
           TO THE UHF SET IS OPEN AND A WORK PLATFORM IS
           POSITIONED PER 112314XM01. ASSUME THE APL IS IN A
           HANGAR. POWER IS CONNECTED TO APL.

------------ TASK TIME SUMMARY ------------

TOTAL MANHOURS:   .93 HRS ....... WITH PF&D:   1.11 HRS

TOTAL ELAPSED:    .46 HRS ....... WITH PF&D:    .56 HRS

GSE REQUIRED:   YES        PERSONAL:   9%

                           FATIGUE:    6%

                           DELAY:      5%

A4

TASK CODE: 152314XM01
=============

SUBOPERATION SUMMARY                    PART NAME: UHF RADIO SYSTEM

| STEP | DESCRIPTION | WORKER : I/D | SIMO : WITH | OCC : | DHU ELAPSED: | TOTAL : |
|------|-------------|--------------|-------------|-------|--------------|---------|
| 01 | CONDUCT FLT LINE TEST TO ISOLATE TROUBLES IN UHF RADIO SYSTEM | 1,2 | | | 4627 | 9254 |
| A | JOB PREPARATION | 1,2 | | 200 | 562 | 1124 |
| B | INSTL TEST EQUIPMENT | 1 | C | 200 | 1096 | 2192 |
| C | SET CONDITIONS FOR TEST | 2 | B | 100 | -60 | -60 |
| D | PERFORM SELF TEST ON ARM-13 | 1,2 | | 200 | 1152 | 2304 |
| E | TEST USING TS-2535/ARM-113 | 1,2 | | 200 | 404 | 808 |
| F | TERMINATE TEST | 1,2 | | 200 | 1413 | 2826 |

A5

STANDARD DATA APPLICATION

PART NAME: UHF RADIO SYSTEM

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | DHU ELAPSED | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| C1 | CONDUCT FLT LINE TEST TO ISOLATE TROUBLES IN UHF RADIO SYSTEM | 1,2 | | | | | | 4627 | 9254 |
| A | JOB PREPARATION | | | | | | 200 | 562 | 1124 |
| 1 | OBTAIN TECHNICAL INFORMATION REQUIRED | 1 | 2 | OMH-OF-01 | 1 | | | -20 | |
| 2 | OBTAIN TEST EQUIPMENT AND TOOLS | 2 | 1 | OOH-OB-D1 | 2 | | | 96 | |
| 3 | FROM SHOP TO APL | 1,2 | | OBM-WO-01 | 37 | | | 333 | |
| 4 | ASIDE TEST EQUIPMENT AND TOOLS | 1,2 | | OOH-OB-D2 | 2 | | | 96 | |
| 5 | UP W/STAND TO ACCESS DOOR | 1 | 5 | OBM-WO-01 | 1 | | | 9 | |
| 6 | TO COCKPIT | 2 | 5 | OBM-WO-01 | 1 | | | -8 | |
| 7 | LOCATE UHF RADIO SW | 2 | | OIT-EV-ZB | | 2 | | 20 | |
| 8 | TURN OFF UHF SWITCH | 2 | 9 | OAC-CM-02 | 1 | | | 8 | |
| 9 | TURN OFF TEST SET PWR SW | 1 | 8 | OAC-CM-02 | 1 | | | -7 | |
| B | INSTL TEST EQUIPMENT | 1 | C | OOH-OB-D1 | 1 | | 200 | 1096 | 2192 |
| 1 | POSIT TEST EQUIPMENT ADJACENT TO UHF RADIO | 1 | | | 1 | | | 48 | |
| 2 | INSTL TEST CABLE ASSEMBLIES TO HOOK TEST EQUIPT PER FIG 5-1 | 1 | | ETF-CE-IC | 9 | | | 765 | |
| 3 | RMV SAFETY WIRE FROM ANTENNA CONNECTOR | 1 | | ONF-ST-RB | 1 | 1 | | 122 | |
| 4 | RMV CONNECTOR FROM ANTENNA CONNECTION TO R/T UNIT | 1 | | ETF-CE-RC | 2 | | | 142 | |
| 5 | RMV CONNECTOR FROM J4 OF R/T UNIT | 1 | | ENF-CB-RC | 1 | | | 19 | |
| C | SET CONDITIONS FOR TEST | | B | | | | 100 | -60 | |
| 1 | SELECT APPROVED TEST FREQUENCY | 2 | | OAC-CM-02 | 1 | | | 20 | |
| 2 | SELECT MANUAL ON MODE SELECTOR | 2 | | OAC-CM-01 | 2 | 3 | | 4 | |
| 3 | VOLUME CONTROL TO MAXIMUM | 2 | | OAC-CM-03 | 1 | | | 17 | |
| 4 | FUNCTION SWITCH OFF | 2 | | OAC-CM-01 | 1 | | | 4 | |
| 5 | TONE AND SQ DISABLE SWITCHES RELEASED | 2 | | OAC-CM-01 | 2 | | | 8 | |
| 6 | PRIMARY PWR SWITCH ON | 2 | | OAC-CM-02 | 1 | | | 8 | |
| D | PERFORM SELF TEST ON ARM-13 | 1,2 | | | | | 200 | 1152 | 2304 |
| 1 | OBSERVE THAT ALL STATUS INDICATORS ON TEST SET INDI-CATE NORMAL | 1 | | OIT-EV-0A | 10 | | | 120 | |
| 2 | PREFORM SELF TEST ON ARM-13 | 1 | | OAC-CM-02 | 4 | | | 32 | |

A6

TASK CODE: 152314XM01
==========

STANDARD DATA APPLICATION   PART NAME: UHF RADIO SYSTEM

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DHU TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 3 | ASSURE ADJUSTMENT OF 960P-1 IS CORRECT | 1 | | OPT-ET-04 | 1 | | | 1000 | |
| E | | | | | | | | | |
| 1 | TEST USING TS-2585/ARM-113 | 1,2 | | OAC-CM-02 | 1 | | 200 | 404 | 808 |
| 1 | TURN TESTER FUNCTION SELECTOR TO POSITION 1 | 1 | | | | | | | 8 |
| 2 | OBSERVE STATUS INDICATORS ARE ALL NORMAL? | 1 | | OIT-EV-ZB | | 1 | | 10 | |
| 3 | TURN FUNCTION SELECTOR TO POSITION 2 | 1 | | OAC-CM-02 | 1 | | | 8 | |
| 4 | OBSERVE RCVR/XMTR, KEY LINE AND CONTROL STATUS INDICATORS (IF A FAULT IS INDICATED, COMPONENT MUST BE REPLACED BEFORE CONTINUING) | 1 | | OIT-EV-ZB | | 3 | | 30 | |
| 5 | CONTINUE TEST IN TABLE 5-1 OF REFERENCE. WILL REQUIRE 21 SWITCH ACTUATIONS | 1,2 | | OAC-CM-02 | 21 | | | 168 | |
| 6 | CONTINUING WITH TEST IN TABLE 5-1 WILL REQUIRE 18 OBSERVATIONS | 1 | | OIT-EV-ZB | | 18 | | 180 | |
| F | | | | | | | | | |
| 1 | TERMINATE TEST | 1,2 | | OAC-CM-02 | 1 | | 200 | 1413 | 2826 |
| 1 | SET RADIO FUNCTION SWITCH TO OFF | 2 | | | | | | | 8 |
| 2 | TURN OFF PRIMARY AIRCRAFT POWER SWITCH | 2 | | OAC-CM-02 | 1 | | | 8 | |
| 3 | DISCONNECT TEST CABLES | 1 | | ETF-CE-RC | 9 | | | 639 | |
| 4 | RECONNECT ANTENNA TO R/NIT | 1 | 7 | ETF-CE-IC | 1 | | | 85 | |
| 5 | SAFETY WIRE CONNECTOR | 1 | 7 | ONF-ST-IB | 1 | | | 202 | |
| 6 | REINSTALL CONNECTOR A J4 | 1 | 7 | ENF-CB-IC | 1 | 1 | | 33 | |
| 7 | STOW TEST CABLES IN TEST BOX | 2 | 4,5,6 | OMH-OP-04 | 1 | | | -19 | |
| 8 | DOWN WORK STAND | 1,2 | | OBM-WO-01 | 1 | | | 9 | |
| 9 | GET TOOLS & TEST EQUIP | 1,2 | | OOH-OB-D1 | 1 | | | 48 | |
| 10 | RETURN TO SHOP | 1,2 | | OBM-WO-01 | 37 | | | 333 | |
| 11 | ASIDE TOOLS & EQUIPMENT | 1,2 | | OOH-OB-D2 | 1 | | | 48 | |

TASK CODE: 112314XM01
=========

PART NAME: UHF RECEIVER-TRANSMITTER

## SUMMARY

APL MODEL: F-15          PART NO:                    ZONE:

TASK DESCRIPTION: *  RMV AND INSTL UHF RECEIVER-
                  *  TRANSMITTER

PREPARED BY: J.VOYTKO      ORG: B7463      DATE: 12-07-83P

REQUESTED BY: J.ROSE       ORG: B7463      REV.

REFERENCES:   TO 1F-15A-2-23GS-00-1

REMARKS:      POWER OFF. THIS ANALYSIS IS AN EXAMPLE OF
              MAINTAINABILITY TIME STANDARDS APPLICATION TO AN
              ORGANIZATIONAL MAINTENANCE TASK ON AN F-15
              AIRPLANE.

-------------- TASK TIME SUMMARY --------------

TOTAL MANHOURS:     .36 HRS ...... WITH PF&D:     .43 HRS

TOTAL ELAPSED:      .36 HRS ...... WITH PF&D:     .43 HRS

AT APL MANHOURS:    .31 HRS ...... WITH PF&D:     .38 HRS

AT APL ELAPSED:     .31 HRS ...... WITH PF&D:     .38 HRS

GSE REQUIRED:    NO              PERSONAL:     9%

                                FATIGUE:      6%

                                DELAY:        5%

A8

SUBOPERATION SUMMARY

TASK CODE: 112314XM01
==========
PART NAME: UHF RECEIVER-TRANSMITTER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | OCC | DHU ELAPSED: 3601 | TOTAL: 3601 |
|---|---|---|---|---|---|---|
| 01 | RMV AND INSTL UHF RECEIVER-TRANSMITTER | | | | 3601 | 3601 |
| A1 | JOB PREPARATION (PRIMARY) | 1 | | 100 | 462 | 462 |
| A | JOB PREPARATION (SECONDARY) | 1 | | 100 | 133 | 133 |
| B | ACCESS DOOR 3R | 1 | | 100 | 207 | 207 |
| C | RMV ELEC CABLES | 1 | | 100 | 473 | 473 |
| D | RMV UHF RECEIVER-TRANSMITTER | 1 | | 100 | 173 | 173 |
| E | GET NEW UHF RECEIVER-TRANSMITTER | 1 | | 100 | 255 | 255 |
| F | INSTL UFH RECEIVER-TRANSMITTER | 1 | | 100 | 246 | 246 |
| G | INSTL ELEC CABLES | 1 | | 100 | 729 | 729 |
| H | CLOSE DOOR 3R | 1 | | 100 | 372 | 372 |
| J | JOB TERMINATION | 1 | | 100 | 551 | 551 |

A9

STANDARD DATA APPLICATION

PART NAME: UHF RECEIVER-TRANSMITTER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | DHU ELAPSED | DHU TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 01 | RMV AND INSTL UHF RECEIVER-TRANSMITTER | | | | | | | 3601 | 3601 |
| A1 | JOB PREPARATION (PRIMARY) | 1 | | | | | 100 | 462 | 462 |
| 1 | GET FORM 781 | | | OMH-LA-0A | 1 | | | 5 | |
| 2 | READ DISCREPANCY | | | ORD-TM-D2 | 1 | | | 438 | |
| 3 | GET TOOLS & EQUIPMENT | | | OMH-LA-0C | 1 | | | 19 | |
| A | JOB PREPARATION (SECONDARY) | 1 | | | | | 100 | 133 | 133 |
| 1 | ASIDE TOOLS & EQUIPMENT | | | OMH-LA-0C | 1 | | | 19 | |
| 2 | GET SMALL W/STAND | | | OOH-0B-D8 | 1 | | | 114 | |
| B | ACCESS DOOR 3R | 1 | | | | | 100 | 207 | 207 |
| 1 | RELEASE DOOR LATCH FASTNERS | | | ONF-FT-RB | 1 | 2 | | 32 | |
| 2 | DISENGAGE DOOR LATCHES | | | OOH-DE-0C | 3 | | | 66 | |
| 3 | POSN SMALL W/STAND | | | OOH-0B-D7 | 1 | | | 51 | |
| 4 | UP SMALL W/STAND | | | OBM-WO-01 | 1 | | | 9 | |
| 5 | OPEN DGOR 3R WITH H/O ROD | | | OJP-AC-D1 | 1 | | | 49 | |
| C | RMV ELEC CABLES | 1 | | | | | 100 | 473 | 473 |
| 1 | RMV QWIK DISCONNECT CABLES | | | ENF-CB-RC | 2 | | | 38 | |
| 2 | RMV SAFETY WIRE RF CABLE | | | ONF-ST-RC | 1 | | | 208 | |
| 3 | RMV RF CABLE | | | ETF-CE-RC | 1 | | | 71 | |
| 4 | CAP CABLES & CONNECTORS | | | OTF-CF-IB | 6 | | | 156 | |
| D | RMV UHF RECEIVER-TRANSMITTER | 1 | | | | | 100 | 173 | 173 |
| 1 | LOOSEN LRU RATCHET FASTNER | | | OTF-BF-RC | 2 | | | 118 | |
| 2 | POSN SWIVEL BOLT | | | OOH-PO-DA | 2 | | | 24 | |
| 3 | DISENGAGE UHF | | | OOH-DE-0C | 1 | | | 22 | |
| 4 | DOWN SMALL W/STAND | | | OBM-WO-01 | 1 | | | 9 | |
| E | GET NEW UHF RECEIVER-TRANSMITTER | 1 | | | | | 100 | 255 | 255 |
| 1 | ASIDE OLD UHF | | | OMH-LA-0B | 1 | | | 12 | |
| 2 | OPEN CARDBOARD BOX | | | OPK-0B-R2 | 1 | | | 168 | |
| 3 | RMV UHF FROM DESICCATED PKG | | | OPK-0B-R1 | 1 | | | 49 | |
| 4 | INSP NEN UHF | | | OIT-EV-0A | 1 | 1 | | 17 | |
| 5 | UP SMALL W/STAND | | | OBM-WO-01 | 1 | | | 9 | |
| F | INSTL UFH RECEIVER-TRANSMITTER | 1 | | | | | 100 | 246 | 246 |
| 1 | POSN UHF | | | OOH-PO-OC | 1 | | | 42 | |

TASK CODE: 112314XM01

STANDARD DATA APPLICATION     PART NAME: UHF RECEIVER-TRANSMITTER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC: ADD | DHU: ELAPSED | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 2 | POSN SWIVEL BOLTS | | | OOH-PO-OA | 2 | | 24 | |
| 3 | TIGHTEN LRU RATCHET FASTENER | | | OTF-BF-IC | 2 | | 128 | |
| 4 | REPOSN UHF | | | OOH-PO-OA | 1 | | 12 | |
| 5 | FINAL TIGHTEN LRU RATCHET FASTENER (EQ TO) | | | OTL-WT-ZZ | | 2 | 40 | |
| G | INSTL ELEC CABLES | 1 | | | | 100 | 729 | 729 |
| 1 | RMV CAPS CABLES & CONNECTORS | | | OTF-CF-RB | 6 | | 144 | |
| 2 | INSTL RF CABLE | | | ETF-CE-IC | 1 | | 85 | |
| 3 | SAFETY RF CABLE | | | ONF-ST-IC | 1 | | 275 | |
| 4 | INSTL QWIK DISCONN CABLES | | | ENF-CB-IB | 2 | | 44 | |
| 5 | INSP INSTALLATION | | | OIT-EV-OB | 1 | 3 | 51 | |
| 6 | POLICE AREA | | | OEL-ET-O3 | 1 | | 100 | |
| 7 | RMV RFI TAG | | | OOH-TR-R1 | 1 | | 30 | |
| H | CLOSE DOOR 3R | 1 | | | | 100 | 372 | 372 |
| 1 | CLOSE DOOR 3R WITH H/O ROD | | | OJP-AC-D2 | 1 | | 49 | |
| 2 | DOWN SMALL W/STAND | | | OBM-WO-O1 | 1 | | 9 | |
| 3 | REPOSN SMALL W/STAND | | | OOH-OB-D7 | 1 | | 51 | |
| 4 | POSN DOOR LATCHES | | | OOH-PO-OC | 3 | | 126 | |
| 5 | FASTEN DOOR LATCH FASTENERS | | | ONF-FT-1B | 3 | | 60 | |
| 6 | GET FORM 781 | | | OMH-LA-OA | 1 | | 5 | |
| 7 | RECORD ACTION TAKEN | | | OWR-NT-O2 | 4 | | 72 | |
| J | JOB TERMINATION | 1 | | | | 100 | 551 | 551 |
| 1 | FILL OUT & ATTACH TAG | | | OOH-TR-I2 | 1 | | 418 | |
| 2 | ASIDE SMALL W/STAND | | | OOH-OB-D8 | 1 | | 114 | |
| 3 | GET TOOLS & EQUIP | | | OMH-LA-OC | 1 | | 19 | |

TASK CODE: 552314XM01
==========

PART NAME: UHF COMM SYSTEM

SUMMARY
-------

APL MODEL: ALL

PART NO: AN-ARC-109

ZONE:

TASK DESCRIPTION:
* BENCH TEST UHF AN/ARC-109
* SYSTEM USING RADIO TEST SET
* AN/ARM-113 AT AN INTERMEDIATE
* LEVEL.

PREPARED BY: J.DAVOLT        ORG: B7463        DATE: 1-9-84P

REQUESTED BY: J.ROSE         ORG: B7463        REV.

REFERENCES: TO 12R2-2ARC109-2

REMARKS: DEVELOPED AS AN EXAMPLE OF MAINTAINABILITY TIME
STANDARDS APPLICATION. ASSUMPTIONS ARE AS FOLLOWS:
BENCH TEST SETUP SIMILAR TO FIGURE 5-1 OF REF.
EQUIPMENT TO BE TESTED IS DELIVERED TO SHOP. THIS
TEST SIMILAR TO 152314XM01 WHICH IS PREFORMED ON
APL. BENCH TEST WOULD BE USED TO CONFIRM FINDINGS
ON APL PRIOR TO SENDING UNIT FOR DETAILED
INSPECTION.

--------- TASK TIME SUMMARY ---------

TOTAL MANHOURS:   .18 HRS ...... WITH PF&D:   .21 HRS

TOTAL ELAPSED:    .18 HRS ...... WITH PF&D:   .21 HRS

GSE REQUIRED:  YES            PERSONAL:    5%

                              FATIGUE:     5%

                              DELAY:       5%

A12

PART NAME: UHF COMM SYSTEM

SUBOPERATION SUMMARY

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | OCC | DHU ELAPSED | TOTAL |
|------|-------------|------------|-----------|-----|-------------|-------|
| 01 | BENCH TEST UHF AN/ARC-109 SYSTEM USING RADIO TEST SET AN/ARM-113 AT ORGANIZATIONAL LEVEL. | | | | 1802 | 1802 |
| A | PREPARE FOR TEST | 1 | | 100 | 608 | 608 |
| B | TEST CONTROL (IF CONTROL ONLY IS TESTED USE STEPS 1.4 OF TABLE 5-1) (IF A FAULTY UNIT IS FOUND IT MUST BE REPLACED BEFORE CONTINUING THE TEST) | | | 100 | 126 | 126 |
| C | TEST TRANSCEIVER (IF TRANSCEIVER ONLY IS TESTED USE STEPS 7 THRU 17 OF TABLE 5-1). (IF A FAULTY UNIT IS FOUND IT MUST BE REPLACED BEFORE CONTINUING TEST). | | | 100 | 270 | 270 |
| D | TERMINATE TEST | 1 | | 100 | 798 | 798 |

A13

PART NAME: UHF COMM SYSTEM

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | QTY ADD | OCC | DHU ELAPSED | DHU TOTAL |
|------|-------------|-----------|-----------|------|---------|---------|-----|---------|-------|
| 01 | BENCH TEST UHF AN/ARC-109 SYSTEM USING RADIO TEST SET AN/ARM-113 AT ORGANIZATIONAL LEVEL. | | | | | | | 1802 | 1802 |
| A | PREPARE FOR TEST | 1 | | | | | 100 | 608 | 608 |
| | 1 GET COMPONENTS TO BE TESTED AND LOCATE ON BENCH | 1 | | 00H-0B-D4 | 2 | | | 80 | |
| | 2 ASSURE THAT RADIO SET CONTROL FUNCTION SWITCH IS SET TO OFF AND THE RADIO TEST SET POWER SWITCH IS OFF | 1 | | 0AC-CM-02 | 2 | | | 16 | |
| | 3 CONNECT UNIT TO BE TESTED TO BENCH TEST SET UP A3 SHOWN IN FIGURE 5-2 | 1 | | ETF-CE-IC | 4 | | | 340 | |
| | 4 SET CONTROLS PER PAR. 5-7, F1 THRU 4 | 1 | | 0AC-CM-02 | 9 | | | 72 | |
| | 5 OBSERVE STATUS INDICATOR LIGHTS ON TEST SET. | 1 | | 0IT-EV-ZB | | 10 | | 100 | |
| B | TEST CONTROL (IF CONTROL ONLY IS TESTED USE STEPS 1.4 OF TABLE 5-1) (IF A FAULTY UNIT IS FOUND IT MUST BE REPLACED BEFORE CONTINUING THE TEST) | | | | | | 100 | 126 | 126 |
| | 1 ACTUATE SWITCHES AS REQUIRED BY TABLE 5-1 STEPS 1.4. | 1 | | 0AC-CM-02 | 7 | | | 56 | |
| | 2 OBSERVE RESULTS | 1 | | 0IT-EV-ZB | | 7 | | 70 | |
| C | TEST TRANSCEIVER (IF TRANSCEIVER ONLY IS TESTED USE STEPS 7 THRU 17 OF TABLE 5-1). (IF A FAULTY UNIT IS FOUND IT MUST BE REPLACED BEFORE CONTINUING TEST). | | | | | | 100 | 270 | 270 |
| | 1 ACTUATE SWITCHES AS REQUIRED BY TABLE 5-1 STEPS 7 THRU 17 | 1 | | 0AC-CM-02 | 15 | | | 120 | |
| | 2 OBSERVE RESULTS | 1 | | 0IT-EV-ZB | | 15 | | 150 | |
| D | TERMINATE TEST | 1 | | | | | 100 | 798 | 798 |
| | 1 TURN OFF RADIO SET FUNCTION SWITCH AND TEST SET POWER | 1 | | 0AC-CM-02 | 2 | | | 16 | |

TASK CODE: 552314XM01
=========

STANDARD DATA APPLICATION  PART NAME: UHF COMM SYSTEM

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC: ELAPSED | DHU TOTAL |
|---|---|---|---|---|---|---|---|
| | SWITCH TO OFF. | | | | | | |
| 2 | DISCONNECT UNIT TESTED | 1 | | ETF-CE-RC | 4 | | 284 |
| 3 | FILL OUT DEPOSITION TAGGED FOR | 1 | | 00H-TR-I2 | 1 | | 418 |
| | TESTED UNIT | | | | | | |
| 4 | ASIDE TESTED UNIT | 1 | | 00H-0B-D4 | 2 | | 80 |

TASK CODE: 552314XM02
==========

PART NAME: UHF TRANSCEIVER

SUMMARY
-------

APL MODEL: ALL          PART NO: RT-749/ARC109          ZONE:

TASK DESCRIPTION:   *   FAULT ISOLATE A UHF TRANSCEIVER
                    *   CONFIRMED TO BE INOPERATIVE IN
                    *   BOTH RECEIVE AND TRANSMIT MODES

PREPARED BY: J.DAVOLT        ORG: B7463        DATE: 1-9-84P

REQUESTED BY: J.ROSE         ORG: B7463        REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:   FOR THIS TASK IT IS ASSUMED A UHF TRANSCEIVER IS
           INOPERATIVE AS CONFIRMED BY PREVIOUS TESTS AND IS
           NOW BEING EXAMINED TO DETERMINE THE MODULE CAUSING
           THE PROBLEM. TABLE 6-5 OF REF. T.O., NOTE 1,
           SUGGESTS PERFORMING PART I THEN PART V TO ISOLATE
           FAULT. ASSUME: PART IS ON RECEIVING TABLE IN DEPOT
           ELECTRONIC REPAIR SHOP.

------------------ TASK TIME SUMMARY ------------------

TOTAL MANHOURS:      .38 HRS ...... WITH PF&D:      .44 HRS

TOTAL ELAPSED:       .38 HRS ...... WITH PF&D:      .44 HRS

GSE REQUIRED:   YES              PERSONAL:     5%

                                 FATIGUE:      5%

                                 DELAY:        5%

A16

SUBOPERATION SUMMARY

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER : SIMO : I/B : WITH | DCC | DMU ELAPSED: | DMU TOTAL : |
|------|-------------|---------------------------|-----|--------------|-------------|
| 62 | FAULT ISOLATE A UHF TRANSCEIVER CONFIRMED TO BE INOPERATIVE IN BOTH RECEIVE AND TRANSMIT MODES | | | 3812 | 3812 |
| A | PREPARE FOR TEST | | 100 | 2352 | 2352 |
| B | MAIN RECEIVER & TRANSMITTER INOPERATIVE TEST(PART I) | | 100 | 936 | 936 |
| C | FREQUENCY GENERATING CIRCUITS INOPERATIVE TEST (PART V) | 1 | 100 | 451 | 451 |
| E | TEST TERMINATION | | 100 | 73 | 73 |

STANDARD DATA APPLICATION                    PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CC/E | QTY 1ST | QTY ADD | OCC | ELAPSED DHU | TOTAL |
|------|-------------|------------|-----------|------|---------|---------|-----|-------------|-------|
| #2 | FAULT ISOLATE A UHF TRANSCEIVER CONFIRMED TO BE INOPERATIVE IN BOTH RECEIVE AND TRANSMIT MODES | | | | | | | 3812 | 3812 |
| A | PREPARE FOR TEST | | | | | | 100 | 2352 | 2352 |
| 1 | REVIEW TECH DATA | | | ORD-TM-D1 | 1 | 4 | | 2352 | |
| 2 | MOVE TR UNIT TO TEST BENCH | | | DOH-OB-D4 | 1 | | | 1421 | |
| 3 | DEPRESSURIZE UNIT | | | CON-PO-OC | 2 | | | 81 | |
| 4 | RMV SCREWS SECURING CASE | | | DIF-SM-RA | 1 | 11 | | 84 | |
| 5 | ASSURE RADIO SET CONTROL FUNCTION SWITCH AND TEST POWER SWITCH ARE OFF | | | OAC-CM-02 | 2 | | | 534 | |
| 6 | DISENGAGE OUTER CASE | | | DOH-DE-OD | 2 | | | 80 | |
| 7 | CONNECT TEST CABLES TO TR UNIT | | | ETF-CE-IB | 2 | | | 136 | |
| B | MAIN RECEIVER & TRANSMITTER INOPERATIVE TEST(PART I) | | | | | | 100 | 936 | 936 |
| 1 | TURN ON TEST POWER SW AND SET RADIO SET CONTROL FUNCTION TO MAIN, TUNING MODE TO MANUAL AND MANUAL SELECTOR TO 225.000 MHz | | | OAC-CM-02 | 1 | 6 | | 32 | |
| 2 | MEASURE VOLTAGE AT TEST POINTS 1, 2 AND 3 (IF NORMAL GO TO B6) | | | EIT-TH-D6 | 1 | 2 | | 152 | |
| 3 | IF NO VOLTAGE OBSERVE L2, L3 & L4 ON TEST SET, INSPECT CABLE CONNECTIONS | | | DIT-EV-ZB | | 4 | | 40 | |
| 4 | CHECK VOLTAGE AT J4, J5 & J6 ON TEST SET-IF OUT OF TOLERANCE 60 TO B-5. | | | EIT-TH-Z6 | 3 | | | 89 | |
| 5 | MEASURE VOLTAGE AT F1, F2 & F3 (REPLACE FUSE IN TEST SET-IF REPLACEMENT FUSE BLOWS RMV 1A2 AND 1A8 AND RECHECK-TROUBLE IS ISOLATED TO CHASSIS WIRING OR 1A20R1A8). | | | EIT-TH-Z6 | 3 | | | 89 | |
| 6 | MEASURE VOLTAGE AT (H1) (1A8J1) AND GRD | | | EIT-TH-Z6 | 1 | | | 30 | |
| 7 | MEASURE VOLTAGE AT (H2) (1A8J2) AND GRD (CAUTION 560 +VOLTS!) | | | EIT-TH-Z6 | 1 | | | 30 | |
| 8 | MEASURE VOLTAGE AT (H3) (1A8J3) AND GND | | | EIT-TH-Z6 | 1 | | | 30 | |
| 8 | | | | EIT-TH-Z6 | 1 | | | 30 | |
| 9 | MEASURE VOLTAGE AT (H4) (1A8J4) | | | EIT-TH-Z6 | 1 | | | 30 | |

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC ELAPSED | DHU TOTAL |
|------|-------------|-----------|-----------|------|---------|-----|-------------|-----------|
| 10 | MEASURE VOLTAGE AT (H5) (1A8J5) AND GRD | 1 | | EIT-TH-Z6 | 1 | | | 30 |
| 11 | MEASURE VOLTAGE AT (H6) (1A8J6) AND GRD | 1 | | EIT-TH-Z6 | 1 | | | 30 |
| 12 | DISCONN TEST SET AS SHOWN IN FIGURE 6-5 | 1 | | ETF-CE-RB | 2 | | | 57 |
| 13 | CONNECT TEST SET AS SHOWN IN FIGURE 6-6 | 1 | | ETF-CE-IB | 2 | | | 68 |
| 14 | SET RADIO SET CONTROLS PER TABLE 6-4, STEP 12 B THRU C | 1 | | OAC-CM-02 | 5 | | | 40 |
| 15 | OBSERVE VOLTAGE INDICATION | 1 | | OIT-EV-ZB | | | | 10 |
| 16 | PLACE TEST SET MIC KEY TO ON POSITION (IF VOLTAGE IS OUT OF TOLERANCE ADJUST 1A2R6) (IF NO VOLTAGE REPLACE 1A8) (IF FAULT REMAINS IT IS IN CHASSIS WIRNG) | 1 | | OAC-CM-02 | 1 | | | 8 |
| 17 | RETURN SWITCHES TO STEP B-1 CONDITION. | 1 | | OAC-CM-02 | 6 | | | 48 |
| 18 | MEASURE VOLTAGE AT .5 (J21 AND GRD) (IF ABNORMAL CHECK CONTIN-UITY OF CHASSIS WIRING) | 1 | | EIT-TH-Z6 | 1 | | | 30 |
| 19 | ACTUATE TEST SET MIC KEY TO ON | 1 | | OAC-CM-02 | 1 | | | 8 |
| 20 | MEASURE VOLTAGE AT .6 (J22 AND GRD) (IF ABNORMAL SAME AS STEP B-18) | 1 | | EIT-TH-Z6 | 1 | | | 30 |
| 21 | MEASURE VOLTAGE AT .4 (J20 AND GRD) (IF ABNORMAL CHECK CONTIN-UITY OF CHASSIS WIRING) | 1 | | EIT-TH-Z6 | 1 | | | 30 |
| C | FREQUENCY GENERATING CIRCUITS INOPERATIVE TEST (PART V) | | | | | | 100 | 451 |
| 1 | DISCONN "TRANSMIT" HOOKUP | 1 | | ETF-CE-RB | 1 | 2 | | 57 |
| 2 | CONNECT TO "RECEIVE" CONFIGURA-TION PER FIGURE 6-5. | 1 | | ETF-CE-IB | 1 | 2 | | 68 |
| 3 | ASSURE MIC KEY ON TEST SET IS OFF AND SET RADIO CONTROLS AS FOLLOWS: FUNCTION SELECTOR TO MAIN, TUNING SELECTOR TO MANUAL AND MANUAL SELECTORS TO 225.000 MHZ | 1 | | OAC-CM-02 | 6 | | | 48 |
| 4 | MEASURE VOLTAGE AT (E1) (1A5J1) (IF NO VOLTAGE FAULT IS IN FREQ | 1 | | EIT-TH-D6 | 1 | | | 93 |

A19

TASK CODE: 552314XM02
==========

PART NAME: UHF TRANSCEIVER

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC ADD | ELAPSED | DHU TOTAL |
|---|---|---|---|---|---|---|---|---|
| | SYNTHESIZER 1A5 REPLACE 1A5) | 1 | | | | | | |
| 5 | MEASURE FREQUENCY AT (E1) (1A5J1) (IF FREQUENCY IS RANDOM PROCEED TO PART V1) | | | EIT-TH-D6 | 1 | | | 93 |
| 6 | MEASURE VOLTAGE AT (A4) (1A1J4) (IF INDICATION IS ABNORMAL TROUBLE IS IN RELAY 1A5K1 OR CHASSIS WIRING) | | | EIT-TH-D6 | 1 | | | 93 |
| D | TEST TERMINATION | | | | | 100 | | |
| 1 | TURN OFF TEST POWER SWITCH AND RADIO SET CONTROL FUNCTION SWITCH. | | | OAC-CM-02 | 2 | | 73 | 16 |
| 2 | DISCONNECT CONNECTORS TO TRANS-CEIVER. | | | ETF-CE-R3 | 1 | 2 | | 57 |

A20

TASK CODE: 112314XM02
==========

PART NAME: POWER SUPPLY 1A8

SUMMARY
-------

APL MODEL: ALL          PART NO:                              ZONE:

TASK DESCRIPTION:  *     RMV & INSTL MODULE, POWER
                   *     SUPPLY 1A8

PREPARED BY: J.VOYTKO        ORG: B7463      DATE: 12-07-83P

REQUESTED BY: J.ROSE         ORG: B7463      REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:      THIS ANALYSIS IS AN EXAMPLE OF MAINTAINABILITY
              TIME STANDARDS APPLICATION AT THE DEPOT LEVEL.

-------------- TASK TIME SUMMARY --------------

TOTAL MANHOURS:   .12 HRS ...... WITH PF&D:      .14 HRS

TOTAL ELAPSED:    .12 HRS ...... WITH PF&D:      .14 HRS

GSE REQUIRED:  NO              PERSONAL:    8%

                               FATIGUE:     5%

                               DELAY:       5%

A21

TASK CODE: 112314XM02
=============

PART NAME: POWER SUPPLY 1A8

SUBOPERATION SUMMARY

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | OCC | DHU ELAPSED: | TOTAL : |
|------|-------------|------------|-----------|-----|--------------|---------|
| 02 | RMV & INSTL MODULE, POWER SUPPLY 1A8 | | | | 1161 | 1161 |
| A | RMV MODULE AND COVER | | | 100 | 536 | 536 |
| B | INSTL COVER & MODULE | | | 100 | 625 | 625 |

A22

STANDARD DATA APPLICATION

TASK CODE: 112314XM02
==========

PART NAME: POWER SUPPLY 1A8

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC: | ELAPSED | DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 1161 | | 1161 |
| 02 | RMV & INSTL MODULE, POWER SUPPLY 1A8 | | | | | | | | | |
| A | RMV MODULE AND COVER | | | | | | | | | |
| 1 | LOOSEN MODULE HOLD DOWN SCREWS | | | OTL-WT-02 | 1 | 3 | 100 | 536 | | 536 |
| | (EQ TO) | | | | | | | 108 | | |
| 2 | RMV COVER RETAINING SCREWS | | | OTF-SM-RB | 1 | 4 | | 428 | | |
| B | INSTL COVER & MODULE | | | | | | | | | |
| 1 | POSN COVER | | | OOH-PO-OB | 1 | | 100 | 625 | | 625 |
| 2 | INSTL COVER RETAINING SCREWS | | | OTF-SM-IB | 1 | 4 | | 25 | | |
| 3 | POSN MODULE | | | OOH-PO-OC | 1 | | | 450 | | |
| 4 | TIGHTEN MODULE HOLD DOWN SCREWS | | | OTL-WT-02 | 1 | 3 | | 42 | | |
| | (EQ TO) | | | | | | | 108 | | |

A23

TASK CODE: 552314XM03
=============

PART NAME: UHF TRANSCEIVER PWR SUPPLY          ZONE:

## SUMMARY

APL MODEL: ALL          PART NO: 1A8

TASK DESCRIPTION:     *    TROUBLESHOOT UHF TRANSCEIVER
                      *    POWER SUPPLY (1A8) THAT HAS A
                      *    FAULTY 26.5 VDC OUTPUT

PREPARED BY:  J.DAVOLT          ORG: B7463          DATE: 1-9-84P

REQUESTED BY: J.ROSE           ORG: B7463          REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:      THIS ANALYSIS IS AN EXAMPLE OF A DEPOT LEVEL
              MAINTAINABILITY TIME STANDARDS APPLICATION. IT IS
              ASSUMED THAT 552314XM02 INDICATED THE POWER SUPPLY
              MODULE (1A8) COULD NOT BE ADJUSTED TO OBTAIN 26.5
              VDC. TROUBLE SHOOTING PROCEDURES FOR 1A8 MODULE
              WITH FAULTY +26.5 VDC OUTPUT IS USED FOR THIS
              ANALYSIS.

----------- TASK TIME SUMMARY -----------

TOTAL MANHOURS:     .27 HRS ....... WITH PF&D:     .31 HRS

TOTAL ELAPSED:      .27 HRS ....... WITH PF&D:     .31 HRS

GSE REQUIRED:   YES               PERSONAL:     5%

                                  FATIGUE:      5%

                                  DELAY:        5%

A24

SUBOPERATION SUMMARY

PART NAME: UHF TRANSCEIVER PWR SUPPLY

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | OCC | DHU ELAPSED | TOTAL |
|------|-------------|------------|-----------|-----|-------------|-------|
| 03 | TROUBLESHOOT UHF TRANSCEIVER POWER SUPPLY (1A8) THAT HAS A FAULTY 26.5 VDC OUTPUT | | | | 2732 | 2732 |
| A | SET UP TEST BENCH FOR 1A8 MODULE TEST | 1 | | 100 | 1650 | 1650 |
| B | VERIFY FAULTY VOLTAGE AT 1A8J4 | 1 | | 100 | 141 | 141 |
| C | TRANSISTOR CHECK | 1 | | 100 | 941 | 941 |

TASK CODE: 552314XM03

PART NAME: UHF TRANSCEIVER PWR SUPPLY

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC ELAPSED | DHU ELAPSED | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 03 | TROUBLESHOOT UHF TRANSCEIVER POWER SUPPLY (1A8) THAT HAS A FAULTY 26.5 VDC OUTPUT | | | | | | | 2732 | 2732 |
| A | SET UP TEST BENCH FOR 1A8 MODULE TEST | 1 | | | | | 100 | 1650 | 1650 |
| 1 | GET DEFECTIVE MODULE TO BENCH | 1 | | 81A003I | 1 | | | 48 | |
| 2 | REVIEW TECHNICAL DATA | 1 | | 84A404 | 1 | 4 | | 1470 | |
| 3 | GET POWER SUPPLY MAINT FIXTURE MT-4021/ARM-128 AND VTVM ME-243 /FQM | 1 | | 81A003I | 1 | | | 48 | |
| 4 | ASSURE POWER SWITCH FOR TEST SET IS OFF AND THAT RADIO SET FUNCTION SWITCH IS OFF. | 1 | | OAC-CM-C2 | 2 | | | 16 | |
| 5 | HOOK UP MODULE TO RECEIVER- RECEIVER TO TEST BENCH AND RF WATTMETER TO CONNECTOR J3 ON RT UNIT. | 1 | | OTF-CE-IB | 1 | 5 | | 68 | |
| B | VERIFY FAULTY VOLTAGE AT 1A8J4 | 1 | | | | | 100 | 141 | 141 |
| 1 | TURN ON TEST POWER, FUNCTION SW TO MAIN, TUNING MODE TO MANUAL AND MANUAL SELECTOR TO 225.000 MHZ | 1 | | OAC-CM-02 | 6 | | | 48 | |
| 2 | CHECK VOLTAGE OUTPUT AT (H4) (1A8J4) (IF VOLTAGE IS 34 UDC CONTINUE) | 1 | | EIT-TH-D6 | 1 | | | 93 | |
| C | TRANSISTOR CHECK | | | | | | 100 | 941 | 941 |
| 1 | WITH POWER STILL ON MAKE VOLT- AGE CHECKS OF Q1, Q2, Q3 AND Q8 PER TABLE 6-35. | 1 | | EIT-TH-D6 | 1 | 11 | | 418 | |
| 2 | TURN OFF TEST SET POWER AND RADIO SET FUNCTION SWITCH TO OFF | 1 | | OAC-CM-02 | 2 | | | 16 | |
| 3 | CHECK RESISTANCE OF Q1, Q2, Q3 AND Q8 PER TABLE 6-35. | 1 | | EIT-TH-D6 | 1 | 11 | | 418 | |
| 4 | CHECK Q1 AND CR23 FOR SHORT AND Q3 FOR OPEN. (REPLACE FAULTY PARTS AND CONDUCT MINIMUM PERFORMANCE TEST.) | 1 | | EIT-TH-Z6 | 3 | | | 89 | |

TASK CODE: 112314XM03
=========

PART NAME: POWER SUPPLY 1A8                    ZONE:

SUMMARY
-------

APL MODEL: ALL           PART NO:

TASK DESCRIPTION: *       RMV & INSTL CAPACITOR C8

PREPARED BY: J.VOYTKO        ORG: B7463       DATE: 12-07-83P

REQUESTED BY: J.ROSE         ORG: B7463       REV.

REFERENCES:     TO 12R2-2ARC109-2

REMARKS:        THIS ANALYSIS IS AN EXAMPLE OF A DEPOT LEVEL
                MAINTAINABILITY TIME STANDARDS APPLICATION.

------------------- TASK TIME SUMMARY -------------------

TOTAL MANHOURS:    .04 HRS  ...... WITH PF&D:    .05 HRS

TOTAL ELAPSED:     .04 HRS  ...... WITH PF&D:    .05 HRS

GSE REQUIRED:   NO              PERSONAL:    8%

                                FATIGUE:     5%

                                DELAY:       5%

A27

TASK CODE: 112314XM03
==========

PART NAME: POWER SUPPLY 1A8

SUBOPERATION SUMMARY

| STEP | DESCRIPTION | WORKER : SIMO : I/D : WITH | OCC | DHU ELAPSED | DHU TOTAL |
|------|-------------|------|-----|---------|-------|
| 03 | RMV & INSTL CAPACITOR C8 | | | 415 | 415 |
| A | RMV & INSTL CAPACITOR | 1 | 100 | 415 | 415 |

A28

STANDARD DATA APPLICATION          PART NAME: POWER SUPPLY 1A8

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC: | DHU ELAPSED: | TOTAL: |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 415 | 415 |
| 03 | RMV & INSTL CAPACITOR C8 | | | | | | | 415 | 415 |
| A | RMV & INSTL CAPACITOR | I | | | | | 100 | 415 | |
| 1 | UNSOLDER CAPACITOR | | | ETP-DS-R4 | 1 | 1 | | 37 | |
| 2 | ASIDE CAPACITOR | | | OMH-LA-0A | 1 | | | 5 | |
| 3 | GET NEW CAPACITOR | | | OMH-LA-0A | 1 | | | 5 | |
| 4 | UNPK CAPACITOR | | | OPK-OB-R1 | 1 | | | 49 | |
| 5 | CHECK PART NUMBER | | | OIT-EV-OB | 1 | | | 21 | |
| 6 | FORM LEADS (EQ TO) | | | OOH-PO-OB | 2 | | | 50 | |
| 7 | CUT LEADS TO LENGTH | | | OTL-PD-01 | 1 | 1 | | 28 | |
| 8 | APPLY FLUX TO LEADS & TERMINAL | | | EST-CH-D1 | 1 | 3 | | 24 | |
| 9 | POSN END OF CAPACITOR LEADS | | | OOH-PO-OB | 2 | | | 50 | |
| 10 | SOLDER LEADS | | | ETP-SE-I2 | 2 | | | 103 | |
| 11 | CLEAN SOLDER JOINTS | | | ECL-CK-D1 | 1 | 1 | | 31 | |
| 12 | INSP INSTLN | | | OIT-EV-0A | 1 | | | 12 | |

TASK CODE: 502314XM01
==========

PART NAME: UHF TRANSCEIVER PWR SUPPLY

## SUMMARY

APL MODEL: ALL                PART NO: 1A8                ZONE:

TASK DESCRIPTION:    *    MINIMUM PERFORMANCE TEST OF UHF
                     *    PWR SUPPLY MODULE 1A8

PREPARED BY:  J.DAVOLT        ORG: B7463        DATE: 1-9-84P

REQUESTED BY: J.ROSE          ORG: B7463        REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:      DEVELOPED FOR USE AS AN EXAMPLE OF A DEPOT LEVEL
              MAINTAINABILITY TIME STANDARDS APPLICATION. THIS
              MINIMUM PERFORMANCE TEST ASSUMES TROUBLE SHOOTING
              HAS LOCATED A FAULTY PART. PART HAS BEEN REPLACED
              AND MODULE IS TO BE CHECKED PRIOR TO ISSUE FOR
              SERVICE. THIS TEST MAY ALSO BE USED TO ASSIST IN
              ISOLATING A FAULT. ASSUME THAT PWR SUPPLY IS
              INSTLD IN THE STANDARD TEST SET UP ON TEST BENCH.

------------------ TASK TIME SUMMARY ------------------

TOTAL MANHOURS:   .27 HRS ........ WITH PF&D:    .31 HRS

TOTAL ELAPSED:    .27 HRS ........ WITH PF&D:    .31 HRS

GSE REQUIRED:  NO                 PERSONAL:       5%

                                  FATIGUE:        5%

                                  DELAY:          5%

A30

TASK CODE: 502314XM01
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SUBOPERATION SUMMARY

PART NAME: UHF TRANSCEIVER PWR SUPPLY

| STEP | DESCRIPTION | WORKER I/D | SIMD WITH | OCC | DMU ELAPSED | TOTAL |
|---|---|---|---|---|---|---|
| 01 | MINIMUM PERFORMANCE TEST OF UHF PWR SUPPLY MODULE 1A8 | 1 | | | 2658 | 2658 |
| A | PREPARATION FOR TEST | 1 | | 103 | 1410 | 1410 |
| B | CONDUCT MINIMUM PERFORMANCE TEST | | | 100 | 514 | 514 |
| C | TERMINATE TEST | | | 100 | 734 | 734 |

STANDARD DATA APPLICATION        PART NAME: UHF TRANSCEIVER PWR SUPPLY

| STEP | DESCRIPTION | MARKER I/C | SIMO WITH | CODE | QTY 1ST | ADD | OCC | DMU ELAPSED | TOTAL |
|------|-------------|------------|-----------|------|---------|-----|-----|-------------|-------|
| 01 | MINIMUM PERFORMANCE TEST OF UHF PWR SUPPLY MODULE 1A8 | 1 | | | | | | 2658 | 2658 |
| A | PREPARATION FOR TEST | | | | | | 100 | 1410 | 1410 |
| | 1 REVIEW TECHNICAL DATA | 1 | | ORD-TM-D2 | 1 | | | 1410 | |
| | 2 CHECK TEST SET UP CONNECTIONS AND AVAILABILITY OF EQUIPMENT | 2 | | OIT-EV-28 | 3 | 15 | | 1212 | |
| | 3 SET TEST PWR SWITCH TO ON. RADIO SET FUNCTION SWITCH TO MAIN. TUNING MODE SELECTOR TO MANUAL. MANUAL SELECTORS FOR 225.000 MHZ | 1 | | OAC-CM-02 | 6 | | | 150 | |
| | | | | | | | | 48 | |
| B | CONDUCT MINIMUM PERFORMANCE TEST | | | | | | 100 | 514 | 514 |
| | 1 CHECK VOLTAGE | | | EIT-TH-D6 | 1 | | | 93 | |
| | 2 SET MIC KEY ON TEST SET ON | | | OAC-CM-02 | 6 | | | 48 | |
| | 3 CHECK VOLTAGE | | | EIT-TH-Z6 | 6 | 11 | | 326 | |
| | 4 SET MIC KEY ON TEST SET OFF ABOVE ELEMENTS WILL ALLOW COMPLETING THE 6 STEPS IN TABLE 6-37. SHOULD MODULE FAIL THIS TEST THE TROUBLE ISOLATION TESTS IN TABLE 6-38 SHOULD BE CONTINUED. | | | OAC-CM-02 | 6 | | | 48 | |
| C | TERMINATE TEST | | | | | | 100 | 734 | 734 |
| | 1 TURN OFF TEST POWER SWITCH AND RADIO SET FUNCTION SWITCH TO OFF | | | OAC-CM-02 | 6 | | | 48 | |
| | 2 DISCONN PWR SUPPLY FROM MAINT FIXTURE MT-4021/ARM-128 AND VTVM ME-243/FQM | | | ETF-CE-RB | 4 | | | 228 | |
| | 3 TAG PWR SUPPLY FOR DISPOSITION | | | OOH-TR-I2 | 1 | | | 418 | |
| | 4 RETURN TEST EQUIPMENT TO STORAGE CABINET | | | OOH-OB-D5 | 1 | | | 40 | |

A32

TASK CODE: 502314XM02
==========

PART NAME: UHF TRANSCEIVER

SUMMARY
-------

APL MODEL: F-15        PART NO:                          ZONE:

TASK DESCRIPTION:  *   PERFORM MINIMUM PERFORMANCE
                   *   TEST ON UHF RADIO RECEIVER
                   *   TRANSMITTER

PREPARED BY: J.DAVOLT        ORG: B7463        DATE: 12-13-83P

REQUESTED BY: J.ROSE         ORG: B7463        REV.

REFERENCES:   TO 12R2-2ARC109-2

REMARKS:   THIS ANALYSIS IS AN EXAMPLE OF A DEPOT LEVEL
           MAINTAINABILITY TIME STANDARDS APPLICATION. THE
           UHF RADIO AN/ARC 109 IS INSTALLED ON F-15
           AIRCRAFT. THE FOLLOWING MINIMUM PERFORMANCE TEST
           IS TO BE PERFORMED TO QUALIFY THE T/R UNIT FOR
           SERVICE FOLLOWING REPLACEMENT OF ANY MODULE OR
           OTHER MAINTENANCE ON THE T/R UNIT CHASSIS. IT IS
           ASSUMED T/R UNIT TO BE TESTED HAS HAD A POWER
           SUPPLY MODULE 1A8 REPLACED.

------------------ TASK TIME SUMMARY ------------------

TOTAL MANHOURS:   2.38 HRS ....... WITH PF&D:   2.74 HRS

TOTAL ELAPSED:    2.38 HRS ....... WITH PF&D:   2.74 HRS

GSE REQUIRED:  YES            PERSONAL:   5%

                             FATIGUE:    5%

                             DELAY:      5%

SUBOPERATION SUMMARY

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | OCC | DHU ELAPSED | TOTAL |
|------|-------------|------------|-----------|-----|-------------|-------|
| 02 | PERFORM MINIMUM PERFORMANCE TEST ON UHF RADIO RECEIVER TRANSMITTER | | | | 23839 | 23839 |
| A | PREPARE FOR TEST OF RECEIVER PER FIGURE 6-5 OF REF | 1 | | 100 | 282 | 282 |
| B | MAIN RECEIVER SENSITIVITY TEST | 1 | | 100 | 1658 | 1658 |
| C | GUARD RECEIVER SENSITIVITY TEST | 1 | | 100 | 504 | 504 |
| D | MAIN RECEIVER SQUELCH CHARACTERISTICS | 1 | | 100 | 564 | 564 |
| E | GUARD RECEIVER SQUELCH CHARACTERISTICS | | | 100 | 522 | 522 |
| F | MAIN RECEIVER AGC CHARACTERISTICS | | | 100 | 1786 | 1786 |
| G | GUARD RECEIVER AGC CHARACTERISTICS | | | 100 | 410 | 410 |
| H | MAIN RECEIVER FREQUENCY RESPONSE | | | 100 | 1247 | 1247 |
| I | GUARD RECEIVER FREQ RESPONSE | | | 100 | 1178 | 1178 |
| J | MAIN RECEIVER NOISE LEVEL | | | 100 | 461 | 461 |
| K | GUARD RECEIVER NOISE LEVEL | | | 100 | 404 | 404 |
| L | AUXILIARY AUDIO CIRCUIT | | | 100 | 1629 | 1629 |
| M | PREPARE FOR TRANSMITTER TESTS | | | 100 | 538 | 538 |
| N | TRANSMITTER RF POWER OUTPUT | | | 100 | 1940 | 1940 |
| P | TRANSMITTER FREQUENCY ACCURACY | | | 100 | 2257 | 2257 |
| Q | TRANSMITTER MODULATION CONTROL | | | 100 | 3761 | 3761 |
| R | TEST MODULATION FIDELITY OF TRANSFER (TEST EQUIPMENT SETUP AND ADJUSTMENTS AS IN STEP Q) | | | 100 | 1313 | 1313 |
| S | TEST TRANSMITTER TONE MODU-LATION (TEST CONFIGURATION AS | | | 100 | 547 | 547 |

TASK CODE: 502314XM02
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SUBOPERATION SUMMARY

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER : SIMO I/D : WITH | OCC | DHU ELAPSED | TOTAL |
|---|---|---|---|---|---|
| | IN STEP R) | | | | |
| T | TEST TRANSMITTER SIDETONE (TEST CONFIG AS IN STEP S) | | 100 | 176 | 176 |
| U | TEST TRANSMITTER REFLECTOMETER | | 100 | 2643 | 2643 |
| V | TERMINATE TEST | | 100 | 20 | 20 |

PART NAME: UHF TRANSCEIVER

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 02 | PERFORM MINIMUM PERFORMANCE TEST ON UHF RADIO RECEIVER TRANSMITTER | | | | | | | 23839 | 23839 |
| A | PREPARE FOR TEST OF RECEIVER PER FIGURE 6-5 OF REF | 1 | | | 1 | | 100 | 282 | 282 |
| 1 | OBSERVE THAT SWITCHES ON TEST SET ARE OFF | 1 | | OIT-EV-ZA | 1 | 5 | | 25 | |
| 2 | POSIT R/T UNIT ON TEST BENCH | 1 | | OOH-PO-OC | 1 | | | 42 | |
| 3 | WALK FROM RECEIVING TABLE TO TEST BENCH CARRYING R/T UNIT | 1 | | OBM-WO-O1 | 1 | | | 9 | |
| 4 | CONNECT TEST CABLE TO J3 | 1 | | OTF-CE-IC | 1 | | | 85 | |
| 5 | RMV AUXILIARY SQUELCH 960P-1 IF INSTLD | 1 | | OTF-CE-RC | 1 | | 50 | 71 | 36 |
| 6 | CONNECT TEST CABLE TO AUXILIARY SQUELCH FORMER LOCATION ON R/T | 1 | | OTF-CE-IC | 1 | | | 85 | |
| B | MAIN RECEIVER SENSITIVITY TEST | 1 | | OAC-CM-02 | 1 | | 100 | 1658 | 1658 |
| 1 | PLACE 3-PHASE TEST PWR SWITCH IN THE ON POSIT, OBSERVE 3-PHASE INDICATOR LIGHTS ON | | | OAC-CM-02 | 2 | | | 16 | |
| 2 | PLACE RT-749/ARC109 ON-OFF SWITCH TO ON. OBSERVE INDICATORS | | | OAC-CM-02 | 1 | | | 8 | |
| 3 | SET SIGNAL GENERATOR PWR SWITCH TO ON. OBSERVE INDICATORS ON | | | OAC-CM-02 | 1 | | | 8 | |
| 4 | OBSERVE READING OF 150 OHMS ON VTVM AUDIO OUTPUT METER | | | OIT-EV-ZA | 1 | 1 | | 5 | |
| 5 | ADJUST RADIO SET CONTROLS, FUNCTION TO MAIN, TUNING MODE SET TO MANUAL, VOL FULLY ON, MANUAL SELECTORS TO 399.5 MHZ AND SQUELCH TO DISABLE | | | OAC-CM-02 | 8 | | | 64 | |
| 6 | ADJUST CONTROLS ON SIGNAL GENERATOR AS FOLLOWS: MOD SEL TO 1000 HZ, FREQ CONT MEGACYCLE DIAL INDICATOR FOR 399.95 MHZ, OUTPUT ATTENUATOR CONTROL FOR 10UV, AND MOD LEVEL FOR 30 PERCENT | | | OAC-CM-03 | 5 | | 85 | 85 | |
| 7 | ON SIGNAL GENERATOR ADJUST FINE FREQ ADJUST UNTIL MAX DIP IN | | | OAC-CM-04 | 1 | | | 47 | |

A36

TASK CODE: 502314XM02
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PART NAME: UHF TRANSCEIVER

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DHU | TOTAL |
|------|-------------|------------|-----------|------|---------|-----|-----|---------|-----|-------|
| | AGC VOLTAGE IS INDICATED ON VTVM | | | | | | | | | |
| 8 | ADJUST SIGNAL GENERATOR LEVEL BY ADJUSTING OUTPUT ATTENUATOR FOR 3.0 UA MODULATED 30% AT 1000 HZ | | | OAC-CM-04 | 3 | | | | 141 | |
| 9 | ON OUTPUT PWR METER OBSERVE AUDIO POWER OUTPUT INDICATION. SHOULD BE 15 MW MINIMUM | | | DIT-EV-ZB | | 1 | | | 10 | |
| 10 | RECORD READING IN DECIBELS | | | OWR-NT-01 | 1 | | | | 8 | |
| 11 | SWITCH SIGNAL GENERATOR MOD SEL SW TO CW. OBSERVE AUDIO PWR OUTPUT INDICATION ON | | | OAC-CM-04 | 1 | | | | 47 | |
| 12 | RECORD READING IN DECIBELS | | | OWR-NT-01 | 1 | | | | 8 | |
| 13 | RECORD DIFFERENCE IN READING IN STEP 10 AND 12 | | | OWR-NT-04 | 1 | | | | 47 | |
| 14 | REPEAT SENSITIVITY TESTS FOR 312.50 MHZ, 244.40 MHZ, 225.00 MHZ (STEPS 7 THRU 13) | | | OEL-RS-01 | 388 | | 300 | | 388 | 1164 |
| C | GUARD RECEIVER SENSITIVITY TEST | 1 | | | | | 100 | | 504 | 504 |
| 1 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SELECTOR TO BOTH, MANUAL SELECTOR FOR FREQUENCY AT LEAST 10MHZ FROM GUARD RECEIVER FREQ, AND SQUELCH TO NORMAL | | | OAC-CM-Z2 | | 6 | | | 24 | |
| 2 | DISCONN DC PROBE FROM VTVM TO MAIN RCVR AGC | | | OOH-DE-OB | 1 | | | | 12 | |
| 3 | CONNECT DC PROBE FROM VTVM TO GUARD RCVR AGC | | | OOH-PO-OB | 1 | | | | 25 | |
| 4 | DISABLE GUARD SQUELCH SWITCH ON TEST SET | | | OAC-CM-02 | 1 | | | | c | |
| 5 | ADJUST SIGNAL GENERATOR CONTROLS AS FOLLOWS: MOD SEL TO 1000 HZ, FREQ CONTROL FOR MEGACYCLE DIAL INDICATION OF 243.00 MHZ, OUTPUT ATTENUATOR CONTROL FOR 10 UV AND MOD LEVEL FOR 30 PERCENT | | | OAC-CM-04 | 1 | | | | 47 | |
| 6 | REPEAT SENSITIVITY TESTS FOR 243.00 MHZ FREQ (STEPS 8 THRU | | | OEL-RS-01 | 388 | | | | 388 | |

TASK CODE: 502314XM02
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PART NAME: UHF TRANSCEIVER

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC ELAPSED | DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|
| | B13) | | | | | | | |
| D | MAIN RECEIVER SQUELCH CHARACTERISTICS | 1 | | | | 100 | 564 | 564 |
| 1 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SELECTOR TO MAIN, TUNING MODE SEL TO MANUAL VOL FULLY CW, MANUAL SEL FOR 304.75 MHZ, SQUELCH TO NORMAL | | | OAC-CM-Z2 | 9 | | 36 | |
| 2 | ADJUST SIGNAL GENERATOR CON-TROLS AS FOLLOWS: MOD SEL TO 1000 HZ, FREQ CONTROL FOR MEGACYCLE DIAL INDICATION OF 304.75 MHZ, OUTPUT ATTENUATOR FOR 10.0 UV, MOD LEVEL FOR 30 PERCENT MODULATION ON PERCENT MODULATION METER, ADJUST GEN FINE FREQ ADJUST FOR MAX DIP IN AGC VOLTAGE AS INDICATED ON VTVM | | | OAC-CM-04 | 5 | | 235 | |
| 3 | OBSERVE AUDIO OUTPUT ON OUTPUT POWER METER | | | OIT-EV-ZA | 1 | | 5 | |
| 4 | ADJUST OUTPUT ATTENUATOR OF SIGNAL GENERATOR FULLY CCW WHILE OBSERVING AUDIO OUTPUT METER. RECEIVER ADUIO SHOULD BE CUT OFF | | | OAC-CM-04 | 1 | | 47 | |
| 5 | SLOWLY ADJUST SIGNAL GEN ATTENUATOR WHILE OBSERVING OUTPUT METER. NOTE: EXACT POINT AT WHICH AUDIO OUTPUT APPEARS | | | OAC-CM-04 | 1 | | 92 | |
| 6 | RECORD OBSERVED POWER OUTPUT IN DECIBELS | | | OWR-NT-04 | 1 | | 47 | |
| 7 | SWITCH SIGNAL GEN MOD SEL TO CW | | | OAC-CM-02 | 1 | | 8 | |
| 8 | OBSERVE AND RECORD INDICATION ON POWER METER IN DECIBLES | | | OWR-NT-04 | 1 | | 47 | |
| 9 | RECORD DIFFERENCE IN POWER READINGS IN 8 & 6 (6 DB MIN) | | | OWR-NT-04 | 1 | | 47 | |
| E | GUARD RECEIVER SQUELCH CHARACTERISTICS | | | | | 100 | 522 | 522 |
| 1 | POSIT RADIO SET CONTROL | | | OAC-CM-01 | 1 | | 4 | |

A38

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC | DHU ELAPSED | TOTAL |
|---|---|---|---|---|---|---|---|---|
| | FUNCTION SWITCH TO BOTH | | | | | | | |
| 2 | ADJUST SIGNAL GEN CONT AND RECORD OBSERVATIONS AS IN STEPS D2 THRU D9 EXCEPT ADJUST FREQ TO 243.00 MHZ MEGACYCLE DIAL INDICATION (DIFFERENCE IN DECIBELS RECORDED SHOULD BE 6 & 8 MIN) | | | OEL-RS-01 | 518 | | 518 | 1786 |
| F | MAIN RECEIVER AGC CHARACTERISTICS | | | | | 100 | 1786 | 1786 |
| 1 | ADJUST RADIO SET CONT AS FOLLOWS: FUNCTION SEL TO MAIN, TUNING MOD SEL TO MANUAL, VOL FULL CW, MANUAL SEL FOR 399.95 MHZ, SQUELCH TO NORMAL | | | OAC-CM-03 | 8 | | 136 | |
| 2 | DISCONN VTVM DC PROBE FROM GUARD RCVR AGC ON TEST SET | | | OOH-DE-0B | 1 | | 12 | |
| 3 | CONN VTVM DC PROBE TO MAIN RCVR AGC ON TEST SET | | | OOH-PO-0B | 1 | | 25 | |
| 4 | SET SIGNAL GEN FREQ TO 399.95 MHZ | | | OAC-CM-02 | 1 | | 8 | |
| 5 | SET OUTPUT LEVEL (SIGNAL GEN) OF 1000UV MODULATED 30 PERCENT AT 1000 HZ | | | OAC-CM-02 | 2 | | 16 | |
| 6 | ADJUST VTVM/FREQ METER FINE FREQ ADJUST UNTIL MAX DIP IN AGC VOLTAGE IS INDICATED | | | OAC-CM-04 | 1 | | 47 | |
| 7 | OBSERVE OUTPUT PWR METER INDICATION IN DECIBELS AND RECORD | | | OWR-NT-04 | 1 | | 47 | |
| 8 | ADJUST SIGNAL GEN OUTPUT ATTENUATOR FOR THE FOLLOWING: 3.0 TO 10.0 UV (+1, -5 DB) 10.0 UV TO 0.5 V (+/- 3 DB) 0.5V TO 1.5V (SHALL NOT BLOCK) | | | OAC-CM-04 | 3 | | 141 | |
| 9 | FOR EACH ADJUSTMENT OBSERVE AND RECORD INDICATION OF PWR OUTPUT METER | | | OWR-NT-04 | 3 | | 141 | |
| 10 | REPEAT STEPS F7 THRU F9 AFTER RESETING FREQ FOR 312.50, 244.40, 225.00 MHZ | | | OEL-RS-01 | 329 | 300 | 329 | 987 |

PART NAME: UHF TRANSCEIVER

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC | DHU ELAPSED | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 11 | RESET RADIO SET AND SIGNAL GEN TO ABOVE FREQ | | | OAC-CM-01 | 15 | | 60 | 60 |
| 12 | ADJUST RADIO SET CONT AS FOLLOWS: FUNCTION SEL TO MAIN, TUNING MODE SEL TO MANUAL, VOL FULLY CW, MANUAL SEL FOR 304.75 MHZ, SQUELCH TO NORMAL | | | OAC-CM-02 | 8 | | 64 | |
| 13 | ON VTVM CHECK AGC LEVEL AT J-10 ON TEST SET (NO SIGNAL APPLIED TO RCVR)(3.5 +/- 0.2 VDC) | | | OIT-EV-ZB | 1 | 1 | 10 | |
| 14 | ADJUST IF GAIN (1A6R4) AS REQUIRED TO OBTAIN 3.5 +/- 0.2 UDC | | | ECA-CM-D1 | 1 | 50 | 120 | 60 |
| 15 | RECYCLE RECEIVER TO 304.75 MHZ | | | OAC-CM-01 | 4 | | 16 | |
| 15 | REPEAT F13 | | | OAC-CM-01 | 4 | 100 | 16 / 410 | 410 |
| G | GUARD RECEIVER AGC CHARACTERISTICS | | | | | | | |
| 1 | TURN RADIO SET FUNCTION SWITCH TO BOTH | | | OAC-CM-01 | 1 | | 4 | |
| 2 | SET MANUAL SEL TO AT LEAST 10 MHZ FROM GUARD FREQ | | | OAC-CM-02 | 4 | | 32 | |
| 3 | DISCONN VTVM DC PROBE FROM RCVR AGC TEST SET | | | 00H-DE-0B | 1 | | 12 | |
| 4 | CONN VTVM DC PROBE TO GUARD RCVR AGC TEST POSIT ON TEST SET | | | 00H-PO-0B | 1 | | 25 | |
| 5 | ADJUST SIGNAL GEN FREQ TO 243.00 MHZ WITH AN OUTPUT LEVEL OF 1000 MV MODULATED 30 PERCENT AT 1000 HZ | | | OAC-CM-02 | 1 | | 8 | |
| 6 | REPEAT STEPS F7 THRU F9 | | | OEL-RS-01 | 329 | | 329 | |
| | | | | | | | 1247 | 1247 |
| H | MAIN RECEIVER FREQUENCY RESPONSE | | | | | | | |
| 1 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SEL TO MAIN, TUNING MODE SEL TO MANUAL, VOL FULLY CW, MANUAL SEL FOR 304.75 MHZ, SQUELCH TO NORMAL | | | OAC-CM-02 | 8 | 100 | 64 | |
| 2 | DISCONN VTVM DC PROBE TO GUARD AGC TEST POSIT ON TEST SET | | | 00H-DE-0B | 1 | | 12 | |
| 3 | CONN VTVM DC PROBE TO MAIN RCVR | | | 00H-PO-0B | 1 | | 25 | |

A40

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC: ELAPSED | DHU: | TOTAL: |
|---|---|---|---|---|---|---|---|---|---|
| 4 | TEST POSIT ON TEST SET TURN ON PWR SWITCH ON AUDIO OSCILLATOR AND ADJUST CONTROLS AS FOLLOWS: RANGE TO X10, AMPLITUDE TO 10, FREQ DIAL TO 100 | | | OAC-CM-03 | 4 | | | 68 | 68 |
| 5 | ALLOW FIVE MINUTES FOR WARMUP | | | OPT-TM-01 | 834 | | | 834 | |
| 6 | ADJUST SIGNAL GEN CONTROLS AS FOLLOWS: MOD SEL TO EXT MOD, OUTPUT ATTENUATOR CONT FOR 1000 UV, FREQ TO 304.75 MHZ, CHECK AGC BY FINE ADJUST TO OBTAIN DIP IN AGC VOLTAGE AS IND ON FREQ METER, MOD LEVEL CONTROL FOR 30 PERCENT MODULATION INDICATION ON PERCENT MODULA-TION METER | | | OAC-CM-03 | 4 | | | 68 | |
| 7 | ADJUST AMPLITUDE CONTROL ON AUDIO OSCILLATOR AS REQUIRED TO ACHIEVE 30 PERCENT MODULATION INDICATION | | | OAC-CM-04 | 1 | | 75 | 47 | 35 |
| 8 | OBSERVE AND RECORD AUDIO OUTPUT INDICATION IN DECIBELS (THIS IS THE REFERENCE INDICATION) | | | OWR-NT-04 | 1 | | | 47 | |
| 9 | OBSERVE AUDIO OUTPUT INDICATION WHILE VARYING THE MODULATION FREQUENCY FROM 300 TO 6000 HZ (+1 TO -3 DB RELATIVE TO H8) | | | OAC-CM-04 | 2 | | | 94 | |
| I | GUARD RECEIVER FREQ RESPONSE ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SWITCH TO BOTH, MANUAL SELECTORS TO A FREQUENCY AT LEAST 10MHZ FROM GUARD RCVR FREQUENCY | | | OAC-CM-01 | 5 | 20 | 100 | 1178 | 1178 |
| | 2 REPEAT STEPS H4 THRU H9 | | | OEL-RS-01 | 1158 | | | 1158 | |
| J | MAIN RECEIVER NOISE LEVEL ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SELECTOR TO MAIN, MANUAL SEL FOR 304.75 MHZ, SQUELCH TO NORMAL | | | OAC-CM-01 | 6 | 24 | 100 | 461 | 461 |

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | DISCONN HP 200 AB FROM SIGNAL GEN | | | OTF-CE-RB | 1 | | | 57 | | |
| 3 | ADJUST SIGNAL GEN. CONTROLS AS FOLLOWS: MOD SEL TO 1000, FREQ RANGE TO 3, FREQ CONT FOR A MEGACYCLE DIAL IND OF 304.75 MHZ, OUTPUT ATTENUATOR CONT FOR 1000 MV, MOD LEVEL FOR 30 PERCENT MODULATION IND ON PERCENT MODULATION METER, CHECK ACCURACY OF FQM BY ADJUSTING FINE FREQ ADJUST FOR MAX DIP IN AGC VOLTAGE INDICATED ON FQM | | | OAC-CM-04 | 5 | | | 235 | | |
| 4 | OBSERVE AND RECORD AUDIO PWR OUTPUT INDICATED IN DECIBELS ON OUTPUT PWR METER (SIGNAL PLUS NOISE) | | | OWR-NT-04 | 1 | | | 47 | | |
| 5 | PLACE SIGNAL GENERATOR MOD SELECTOR CONTROL TO CW | | | OAC-CM-01 | 1 | | | 4 | | |
| 6 | OBSERVE AND RECORD PWR OUTPUT (AUDIO PWR DUE TO NOISE) | | | OWR-NT-04 | 1 | | | 47 | | |
| 7 | RECORD DIFFERENCE IN READINGS RECORDED FOR STEPS 4 AND 6 (MIN DIFFERENCE 30 DB) | | | OWR-NT-04 | 1 | | | 47 | | |
| K | GUARD RECEIVER NOISE LEVEL | | | | | | | | | 404 |
| 1 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SEL TO BOTH, MANUAL SELECTORS FOR A FREQ AT LEAST 10 MHZ FROM THE GUARD REVR FREQ, SQUELCH TO NORMAL | | | OAC-CM-01 | 6 | | 100 | 404 | 24 | |
| 2 | REPEAT STEPS J3 THRU J7 | | | OEL-RS-01 | 380 | | | 380 | | |
| L | AUXILIARY AUDIO CIRCUIT | | | | | | | | | 1629 |
| 1 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SEL TO MAIN, TUNING MODE SEL TO MANUAL, VOL FULLY CW, MANUAL SEL FOR 304.75 MHZ, SQUELCH TO NORMAL | | | OAC-CM-01 | 8 | | 100 | 1629 | 32 | |
| 2 | CONN AC VTVM TO THE AUX AUDIO OUTPUT JACK ON TEST SET | | | OTF-CE-IB | 1 | | | 68 | | |
| 3 | TURN AC VTVM PWR SW ON | | | OAC-CM-01 | 1 | | | 4 | | |

A42

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DKU TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 4 | ALLOW FIVE MINUTE WARMUP | | | OPT-TM-01 | 834 | | | 834 | |
| 5 | ADJUST AUDIO OSCILLATOR CONTROL AS FOLLOWS: RANGE TO X10, AMPLITUDE TO 10, FREQ DIAL TO 100 | | | OAC-CM-02 | 3 | | | 24 | 24 |
| 6 | ADJUST SIGNAL GEN CONTROLS AS FOLLOWS: MOD SEL TO EXT MOD, FREQ RANGE TO E, FREQ CONT FOR A MEGACYCLE DIAL IND OF 304.75 MHZ, OUTPUT ATTENUATOR CONT FOR 1000MV | | | OAC-CM-02 | 4 | | | 32 | |
| 7 | ADJUST AUDIO OSCILLATOR AMPLITUDE AS REQUIRED TO ACHIEVE 30 PERCENT MODULATION IND | | | OAC-CM-04 | 1 | | 50 | 47 | |
| 8 | ADJUST FINE FREQ ADJUST ON SIGNAL GEN FOR MAX DIP IN AGC VOLTAGE IND ON FQM | | | OAC-CM-04 | 1 | | | 47 | |
| 9 | OBSERVE AND RECORD AUDIO OUTPUT AS INDICATED ON THE AC VTVM (.25V MIN) | | | OWR-NT-04 | 1 | | | 47 | |
| 10 | ADJUST AUDIO OSCILLATOR FREQ DIAL TO EACH OF THE FOLLOWING FREQUENCIES WHILE MAINTAINING 30 PERCENT M ..ATION OF SIGNAL GEN: 70HZ, 500HZ, 4000HZ AND 7000HZ (SOME ADJUSTMENT OF SIGNAL ALSO REQ) | | | OAC-CM-04 | 8 | | | 376 | |
| 11 | OBSERVE AND RECORD IN DECIBELS THE AUDIO OUTPUT FROM THE AC VTVM (-3 OR +3 DB RELATIVE TO REF INDICATION IN STEP 9) | | | OWR-NT-04 | 3 | | | 141 | |
| M | PREPARE FOR TRANSMITTER TESTS | | | OTF-CE-RB | 1 | | 100 | 538 | 538 |
| 1 | DISCONN SIGNAL GEN FROM RECEIVER AT J3 | | | OTF-CE-RB | 1 | | | 57 | |
| 2 | ASIDE CABLE TO SIGNAL GEN | | | OMH-LA-0B | 1 | | | 12 | |
| 3 | DISCONN AUXILIARY SQUELCH FROM RECEIVER/TRANSMITTER | | | OTF-CE-RB | 2 | | | 114 | |
| 4 | CONN CABLE FROM TEST SET TO RECEIVER/TRANSMITTER | | | OTF-CE-IB | 1 | | | 68 | |
| 5 | CONN CABLE FROM RF WATT METER | | | OTF-CE-IB | 1 | | | 68 | |

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DHU TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | TO R/T BEING TESTED | | | | | | | | |
| 6 | DISCONN AC VTVM FROM J9 ON TEST SET | | | OTF-CE-RB | 1 | | | | 57 |
| 7 | CONN AC VTVM TO J4 ON TEST SET | | | OTF-CE-IB | 1 | | | | 68 |
| 8 | DISCONN OSCILLOSCOPE FROM R/T TEST SET | | | OTF-CE-RB | 1 | | | | 57 |
| 9 | DISCORN DC VTVM FROM TEST SET | | | OOH-DE-OB | 1 | | | | 12 |
| 10 | OBSERVE THAT ALL SWITCHES ON R/T AND TEST EQUIPMENT ARE OFF | | | OIT-EV-ZA | | 5 | | | 25 |
| N | TRANSMITTER RF POWER OUTPUT | | | | | | | 1940 | 1940 |
| 1 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SEL TO MAIN, TUNING MODE TO MANUAL, VOL TO FULL CW, MANUAL SEL FOR 225.00 MHZ, SQUELCH TO NORMAL | | | OAC-CM-01 | 8 | | 100 | | 32 |
| 2 | PLACE 3 PHASE PWR SWITCH TO ON POSIT | | | OAC-CM-01 | 1 | | | | 4 |
| 3 | OBSERVE INDICATOR LIGHTS | | | OIT-EV-ZA | 1 | | | | 50 |
| 4 | PLACE R/T ON/OFF SWITCH (S2) TO ON AND OBSERVE INDICATOR LIGHTS | | | OAC-CM-03 | | 10 | | | 17 |
| 5 | ALLOW EQUIPT A 5 MINUTE WARMUP BEFORE PROCEEDING | | | OPT-TM-01 | 834 | | | | 834 |
| 6 | USING THE AC VTVM, CK VOLTAGE ON TEST SET JACKS J4, J5 AND J6 (117 +/- VAC) | | | EIT-TH-Z6 | | 3 | | | 89 |
| 7 | KEY TRANSMITTER BY OPERATING S3 ON TEST SET. OBSERVE OUTPUT ON RF WATTMETER (324. MIN) | | | OAC-CM-04 | 1 | | | | 47 |
| 8 | REPEAT STEP 7 IN 10MHZ INCREMENTS. CAUTION: DUTY CYCLE LIMIT, 5 MINUTES TRANSMIT, 10 MINUTES RECEIVE | | | OEL-RS-01 | 799 | | | | 799 |
| 9 | ADJUST RADIO SET CONTROLS IN 10MHZ INCREMENTS | | | OAC-CM-01 | 17 | | | | 68 |
| P | TRANSMITTER FREQUENCY ACCURACY | | | | | | | | |
| 1 | SWITCH TEST SET ON/OFF SWITCH (S1) TO OFF POSITION | | | OAC-CM-01 | 1 | | 100 | 2257 | 2257 |
| 2 | DISCONN AC VTVM FROM TEST SW | | | OOH-DE-0A | 1 | | | | 7 |
| 3 | DISCORN CABLE TO RF WATTMETER | | | OTF-CE-RA | 1 | | | | 47 |

STANDARD DATA APPLICATION     PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/B | SIMO WITH | CODE | QTY 1ST ADD | OCC: | ELAPSED: | DMU: TOTAL |
|---|---|---|---|---|---|---|---|---|
| | AT MULTIMETER | | | | | | | |
| 4 | GET FREQ METER AND CABLE FOR HOOK UP IN FIG 6-7 | | | OMM-LA-DB | 2 | | 26 | |
| 5 | CONN FREQ METER AS IN FIG 6-7 | | | OIF-CE-IA | 3 | | 174 | |
| 6 | SWITCH TEST SET ON/OFF SWITCH (S1) TO ON POSITION | | | OAC-CM-01 | 1 | | 4 | |
| 7 | ADJUST RADIO SET CONTROLS AS FOLLOWS: FUNCTION SEL TO MAIN. TUNING MODE SEL TO MANUAL. MANUAL SEL FOR 225.60 MHZ | | | OAC-CM-01 | 6 | | 24 | |
| 8 | ADJUST CONTROLS ON FREQ COUNTER AS FOLLOWS: PWR SW TO ON. FUNCTION SEL TO FREQ. FREQ UNIT TO 1 SEC STB GATE TIME (AN/USM-26) | | | OAC-CM-01 | 3 | | 12 | |
| 9 | ADJUST FREQ COUNTER PLUG-IN UNIT (HP525C) CONTROLS AS FOLLOWS: INPUT FREQ TO 10MEC-500 MC. FREQ DIAL FULLY CCW (LOW END) | | | OAC-CM-01 | 2 | | 8 | |
| 10 | MIC KEY (S3) ON TEST SET TO ON POSIT. OBSERVE TRANSMIT LIGHT ON | | | OAC-CM-03 | 1 | | 17 | |
| 11 | ON FREQ COUNTER PLUG-IN UNIT (HP525C) SLOWLY TURN FREQ DIAL CCW WHILE OBSERVING HP525C LEVEL INDICATOR STOP ON FIRST DIAL CALIBRATION AFTER LEVEL INDICATOR ENTERS GREEN AREA OF SCALE | | | OAC-CM-04 | 2 | | 96 | |
| 12 | READJUST VARIABLE ATTENUATOR AS REQUIRED FOR POINTER TO REACH GREEN AREA | | | OAC-CM-04 | 1 | 75 | 47 | 35 |
| 13 | OBSERVE READING ON FREQ COUNTER (AN/USM-26) AND RECORD | | | OMR-RT-04 | 1 | | 47 | |
| 14 | ADD COUNTER READING IN MHZ RECORDED IN STEP 13 TO FREQ INDICATED BY DIAL SETTING IN STEP 11 (225.60 MHZ +/- 2.8KHZ) | | | OMR-RT-04 | 4 | | 188 | |
| 15 | REPEAT STEPS 10 THRU 14 FOR THE FOLLOWING FREQ: 250.80 MHZ, 288.00 MHZ, 328.00 MHZ, 269.95 | | | OEL-RS-01 | 393 | 400 | 393 | 1572 |

STANDARD DATA APPLICATION  PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD | OCC | DMU ELAPSED | DMU TOTAL |
|---|---|---|---|---|---|---|---|---|
| Q | MHZ (FREQ ERROR +/- 2 KHZ) | | | | | 100 | 3761 | 3761 |
| 1 | TRANSMITTER MODULATION CONTROL SWITCH TEST SET ON/OFF SWITCH (S1) TO OFF POSITION | | | OAC-CM-01 | 1 | | 4 | |
| 2 | DISCONN OUTPUT FROM CN-318/G FROM HP525C (FIG.6-7) | | | OTF-CE-RA | 1 | | 47 | |
| 3 | INSTL OUTPUT FROM CN-318/C TO ATTENUATOR INPUT OF TRANSFER OSCILLATOR (FIG. 6-8) | | | OTF-CE-IA | 1 | | 58 | |
| 4 | CONNECT VIDEO OUTPUT FROM TRANSFER OSCILLATOR TO CABLE TO OSCILLOSCOPE | | | OTF-CE-IA | 1 | | 58 | |
| 5 | CONN MICROPHONE SIMULATOR AND AUDIO OSCILLATOR TO J16 OF TEST SET (FIG 6-8) | | | OTF-CE-IA | 3 | | 174 | |
| 6 | SWITCH TEST SET ON/OFF SWITCH (S1) TO ON POSITION | | | OAC-CM-01 | 1 | | 4 | |
| 7 | TURN ON TEST EQUIPMENT PWR SWITCHES | | | OAC-CM-01 | 6 | | 24 | |
| 8 | ALLOW EQUIPMENT TO WARM UP FOR 15 MINUTES | | | OPT-TM-01 | 2500 | | 2500 | |
| 9 | SET MANUAL SEL ON RADIO SET FOR 399.95 MHZ | | | OAC-CM-01 | 4 | | 16 | |
| 10 | ADJUST TRANSFER OSCILLATOR FREQ MEGACYCLE TO 200 MC | | | OAC-CM-02 | 1 | | 8 | |
| 11 | ADJUST OSCILLOSCOPE CONTROLS AS FOLLOWS: TRIGGER LEVEL FULLY CCW, STABILITY TO PRESET, TRIGGER SLOPE TO 8 INT, TRIGGER MODE TO AUTOMATIC, TIME/CM TO 100 MICRO SEC, MULTIPLIER TO 2, HORIZONTAL DISPLAY TO INTERNAL SWEEP, HORIZONTAL POSIT TO CENTER, SQUARE WAVE CALIBRATOR TO 5 VOLTS, MILLIVOLTS, OFF TO VOLTS | | | OAC-CM-03 | 9 | | 153 | |
| 12 | ADJUST OSCILLOSCOPE PLUG-IN UNIT AS FOLLOWS: AC-DC TO AC, VOLTS/CM TO 2, VARIABLE CW, VERTICAL TO CENTER | | | OAC-CM-03 | 4 | | 68 | |
| 13 | SET AUDIO OSCILLATOR AS | | | OAC-CM-03 | 3 | | 51 | |

STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST ADD: | OCC: | ELAPSED: | DHU | TOTAL: |
|---|---|---|---|---|---|---|---|---|---|
| | FOLLOWS: RANGE TO X10, FREQ DIAL TO 100, AMPLITUDE CONTROL FOR 0.8V OUTPUT (OPEN CIRCUIT) | | | | | | | | |
| 14 | SWITCH ON MIC KEY (S3) ON TEST SET | | | OAC-CM-01 | 1 | | | 4 | |
| 15 | ADJUST COURSE VERNIER CONTROL ON TRANSFER OSCILLATOR AND OSCILLOSCOPE CONTROLS FOR A PRESENTATION OF THE MODULATED CARRIER | | | OAC-CM-04 | 4 | | | 188 | |
| 16 | CHECK PERCENT MODULATION USING THE FOLLOWING FORMULA: PERCENT MODULATION = EMAX-EMIN/ EMAX + EMIN X 100 (80 PERCENT MIN; 95 PERCENT MAX) | | | OEL-ET-01 | 400 | | | 400 | |
| 17 | TURN OFF MIC SWITCH | | | OAC-CM-01 | 1 | | | 4 | |
| R | TEST MODULATION FIDELITY OF TRANSFER (TEST EQUIPMENT SETUP AND ADJUSTMENTS AS IN STEP Q) | | | | | 100 | | 1313 | 1313 |
| 1 | TURN ON MIC KEY SWITCH ON TEST SET | | | OAC-CM-01 | 1 | | | 4 | |
| 2 | OBSERVE OSCILLOSCOPE PRESENTATION FOR PERCENT MODULATION | | | OEL-ET-01 | 400 | | | 400 | |
| 3 | ADJUST AUDIO OSCILLATOR FOR 70 PERCENT MODULATION ON TRANSFER OSCILLATOR (USE FORMULA IN Q16)(70 PERCENT) | | | OEL-ET-01 | 588 | 100 | | 588 | 588 |
| 4 | DISCONN OUTPUT OF T-ATTENUATOR FROM TRANSFER OSCILLATOR | | | OTF-CE-RA | 1 | | | 47 | |
| 5 | CONNECT ABOVE TO HP420B CPYSTAL DETECTOR | | | OTF-CE-IA | 1 | | | 58 | |
| 6 | CONNECT AC VTVM TO CRYSTAL DETECTOR OUTPUT | | | OOM-PO-0A | 2 | | | 24 | |
| 7 | OBSERVE AND RECORD INDICATION ON AC VTVM IN DECIBELS | | | OWR-NT-04 | 1 | | | 47 | |
| 8 | VARY THE FREQ SETING ON THE AUDIO OSCILLATOR FROM 300 TO 6000HZ WHILE OBSERVING DB INDICATION ON AC VTVM (WITHIN +1 -3DB OF DB NOTED IN STEP R7) | | | OAC-CM-04 | 3 | | | 141 | |
| 9 | TURN MIC KEY OFF | | | OAC-CM-01 | 1 | | | 4 | |

STANDARD DATA APPLICATION      PART NAME: UHF TRANSCEIVER

| STEP | WORKER I/D | SIMO WITH | DESCRIPTION | CODE | QTY 1ST | ADD | OCC | ELAPSED DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| S | | | TEST TRANSMITTER TONE MODULATION (TEST CONFIGURATION AS IN STEP R) | | | | 100 | 547 | 547 |
| 1 | | | DISCONN AUDIO OSCILLATOR FROM MICROPHONE SIMULATOR | OTF-CE-RA | 2 | | | 94 | |
| 2 | | | ON RADIO CONTROL SET MANUAL | OAC-CM-02 | 1 | | | 8 | |
| 3 | | | SEL TO 399.95 MHZ ADJUST TRANSFER OSCILLERATOR FREQ MEGACYCLE TO 200MC | OAC-CM-03 | 1 | | | 17 | |
| 4 | | | SWITCH TONE SWITCH (S5) TO ON | OAC-CM-01 OIT-EV-ZB | 1 | 1 | | 4 10 | |
| 5 | | | OBSERVE OSCILLOSCOPE PRESENTATION OF THE MODULATED CARRIER | | | | | | |
| 6 | | | USE FORMULA IN STEP Q16 TO DETERMINE PERCENT MODULATION (90 PERCENT MIN) | OEL-ET-01 | 400 | | | 400 | |
| 7 | | | OBSERVE TONE FREQUENCY | OIT-EV-ZB | | 1 | | 10 | |
| 8 | | | SWITCH TONE SWITCH (S5) OFF | OAC-CM-01 | 1 | | | 4 | |
| T | | | TEST TRANSMITTER SIDETONE (TEST CONFIG AS IN STEP S) | | | | 100 | 176 | 176 |
| 1 | | | GET HEAD SET | OMH-LA-0A | 1 | | | 5 | |
| 2 | | | CONN HEADSET TO TEST SET AT J18 | OOH-PO-0A | 1 | | | 12 | |
| 3 | | | PUT ON AND TAKE OFF HEADSET (EQ TC) | OJP-GS-01 | 1 | | | 49 | |
| 4 | | | TURN ON MIC KEY AND TONE SWITCH ON TEST SET | OAC-CM-01 | 2 | | | 8 | |
| 5 | | | ADJUST VOL CONTROL AND LISTEN FOR 1000 HZ TONE IN HEADSET | OAC-CM-04 | 2 | | | 94 | |
| 6 | | | TURN OFF MIC KEY AND TONE SWITCH | OAC-CM-01 | 2 | | | 8 | |
| U | | | TEST TRANSMITTER REFLECTOMETER | | | | 100 | 2643 | 2643 |
| 1 | | | TURN OFF EQUIPMENT TO BE DISCONNECTED | OAC-CM-01 | 4 | | | 16 | |
| 2 | | | DISCONN OSCILLOSCOPE, TRANSFER OSCILLATOR, AUDIO OSCILLATOR, MICROPHONE SIMULATOR, CH-318/G | OTF-CE-RA | 9 | | | 423 | |
| 3 | | | CONN PROBE OF AC VTVM TO J4 CONNECTOR | OOH-PO-0A | 1 | | | 12 | |

TASK CODE: 502314XM02
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STANDARD DATA APPLICATION

PART NAME: UHF TRANSCEIVER

| STEP | WORKER I/D | SIMO WITH | DESCRIPTION | CODE | QTY 1ST | ADD | OCC ELAPSED | DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | | OF TEST SET | | | | | | |
| 4 | | | ADJUST RADIO SET CONTROLS TO 399.95 MHZ | OAC-CM-01 | 4 | | | 16 | |
| 5 | | | SWITCH MIC KEY (S3) TO ON | OAC-CM-01 | 1 | | | 4 | |
| 6 | | | OBSERVE AND RECORD POWER OUTPUT INDICATED ON RF WATTMETER | OWR-NT-04 | 2 | | | 94 | |
| 7 | | | OBSERVE REFLECTOMETER ON FRONT PANEL OF R/T (M2 METER) (+/- 5 WATTS OF STEP U6) | OIT-EV-ZB | | 2 | | 20 | |
| 8 | | | NOTE: IF M2 PEGS AND RF EXCEEDS 50 WATTS ON WATTMETER DIS- REGARD ABOVE TOLERANCE | OEL-ET-01 | 400 | | 50 | 400 | 200 |
| 9 | | | PUSH PRESS FOR REFL PWR BUTTON ON R/T | OOH-PO-0A | 1 | | | 12 | |
| 10 | | | OBSERVE AND RECORD REFL POWER INDICATION IN STEP 9 (3 WATTS MAX) | OWR-NT-04 | 1 | | | 47 | |
| 11 | | | MIC KEY TO OFF POSITION | OAC-CM-01 | 1 | | | 4 | |
| 12 | | | REPEAT STEPS U4 THRU U11 FOR FREQUENCIES 304.75 AND 225.00 MHZ | OEL-RS-01 | 597 | | 300 | 597 | 1791 |
| 13 | | | MIC KEY TO OFF POSITION | OAC-CM-01 | 1 | | | 4 | |
| V | | | TERMINATE TEST | | | | | | |
| 1 | | | TURN OFF ALL TEST EQUIPMENT PWR SWITCHES | OAC-CM-01 | 5 | | 100 | 20 | 20 |

TASK CODE: 81ALCMST01
=========

PART NAME: MISSILE SAFE STATE TEST

ZONE:

SUMMARY
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APL MODEL: AGM86                    PART NO:

TASK DESCRIPTION:    *  JOB PREPARATION-CHECK FOR
                     *  PRESENCE OF ELECTRICAL ENERGY
                     *  AND CORRECT CONTINUITY OR OPENS
                     *  PRIOR TO CONNECTION TO MISSILE
                     *  ORDANCE AND ARMING AND DISARM-
                     *  ING CIRCUITS

PREPARED BY: J.DAVOLT          ORG: B7463      DATE: 01-14-84P

REQUESTED BY: J.ROSE           ORG: B7463      REV.

REFERENCES:    TO 21M-AGM68-2-1

REMARKS:     THIS  ANALYSIS  IS  AN  EXAMPLE OF MAINTAINABILITY
             TIME  STANDARDS   APPLICATION.  IT  IS  ASSUMED THE
             MISSILE HAS BEEN REMOVED FROM THE CARRIER AIRCRAFT
             AND  IS  INSTALLED  ON MAINTENANCE PEDESTALS. ALL
             ACCESS COVERS FOR MAKING THE SAFE STATE TESTS HAVE
             BEEN  PREVIOUSLY  REMOVED.   PURPOSE OF TEST IS TO
             MAKE   TEST   EQUIPMENT   AND   MISSILE  SAFE  FOR
             INTERMEDIATE MAINTENANCE. (EXAMPLE ONLY)

------------- TASK TIME SUMMARY -------------

TOTAL MANHOURS:    .20 HRS ....... WITH PF&D:    .23 HRS

TOTAL ELAPSED:     .21 HRS ....... WITH PF&D:    .24 HRS

GSE REQUIRED:    NO              PERSONAL:      5%

                                FATIGUE:       5%

                                DELAY:         5%

A50

TASK CODE: 81A1CMST01

PART NAME: MISSILE SAFE STATE TEST

SUBOPERATION SUMMARY

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | OCC | DHU ELAPSED: 2097 | TOTAL 1976 |
|---|---|---|---|---|---|---|
| 01 | JOB PREPARATION-CHECK FOR PRESENCE OF ELECTRICAL ENERGY AND CORRECT CONTINUITY OR OPENS PRIOR TO CONNECTION TO MISSILE ORDANCE AND ARMING AND DISARM-ING CIRCUITS | | | | | |
| A | SET UP SAFE STATE TEST (SST) SELF-TEST | | | 100 | 87 | 87 |
| B | CONNECT EXTERNAL POWER TO TESTER (B DOES NOT APPLY IF SST IS OPERATED USING INTERNAL BATTERY AS POWER SOURCE). | | | 50 | 230 | 115 |
| C | SET UP FOR INTERNAL BATTERY OPERATION (C DOES NOT APPLY IF SST IS OPERATED FROM EXTERNAL POWER) | | | 50 | 12 | 6 |
| D | CHECK OF W13 CABLE | | | 100 | 258 | 258 |
| E | ADAPTER/CABLE SELF-TEST | | | 100 | 189 | 189 |
| F | SAFE STATE TEST | | | 100 | 897 | 897 |
| G | TERMINATE TEST | | | 100 | 425 | 425 |

A51

STANDARD DATA APPLICATION

TASK CODE: 81ALCMSTC?

PART NAME: MISSILE SAFE STATE TEST

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 2097 | | 1976 |
| 01 | JOB PREPARATION-CHECK FOR PRESENCE OF ELECTRICAL ENERGY AND CORRECT CONTINUITY OR OPENS PRIOR TO CONNECTION TO MISSILE ORDANCE AND ARMING AND DISARMING CIRCUITS | | | | | | | | | |
| A | SET UP SAFE STATE TEST (SST) SELF-TEST | | | | | | 100 | 87 | 87 | 87 |
| 1 | GET AND ASIDE SST TESTER | | | OMH-LA-OC | 2 | | | | 38 | |
| 2 | UNLATCH LID OF SST TESTER | | | ONF-LP-OI | 1 | 3 | | | 17 | |
| 3 | RMV LID OT SST TESTER | | | OMH-LA-OB | 1 | | | | 12 | |
| 4 | UNSTOW CABLES FROM LID OF TESTER | | | OJP-CC-05 | 1 | | | | 16 | |
| 5 | ENSURE POWER SW IS OFF | | | OAC-CM-01 | 1 | | | | 4 | |
| B | CONNECT EXTERNAL POWER TO TESTER (B DOES NOT APPLY IF SST IS OPERATED USING INTERNAL BATTERY AS POWER SOURCE). | | | | | | 50 | 230 | 230 | 115 |
| 1 | OBTAIN POWER CABLE W21 | | | OMH-LA-OB | 1 | | | | 12 | |
| 2 | RMV DUST CAPS FROM RECEPTACLE J2 ON FRONT PANEL AND W21 CONNECTORS | | | OTF-CF-RA | 3 | | | | 36 | |
| 3 | CONNECT POWER CABLE W21 TO RECEPTACLE | | | ETF-CE-IA | 2 | | | | 116 | |
| 4 | CONNECT P1 OF AC POWER CABLE TO 118 VAC 400 HZ POWER | | | ETF-CE-IA | 1 | | | | 58 | |
| 5 | SET SST C/B CB1AC IN | | | OAC-CM-01 | 1 | | | | 4 | |
| 6 | SET READOUT/RECALL/EXT ON SWITCH TO EXT ON | | | OAC-CM-01 | 1 | | | | 4 | |
| C | SET UP FOR INTERNAL BATTERY OPERATION (C DOES NOT APPLY IF SST IS OPERATED FROM EXTERNAL POWER) | | | | | | 50 | | 12 | 6 |
| 1 | SET READOUT/RECALL/EXT ON SWITCH TO CENTER POSITION | | | OAC-CM-01 | 1 | | | | 4 | |
| 2 | SET MODE SELECT SWITCH TO MODEI | | | OAC-CM-01 | 1 | | | | 4 | |
| 3 | SET SST CIRCUIT BREAKER CB3BAT IN. | | | OAC-CM-01 | 1 | | | | 4 | |

A52

# TASK CODE: 81ALCMST01

## STANDARD DATA APPLICATION — PART NAME: MISSILE SAFE STATE TEST

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED | DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| D | CHECK OF W13 CABLE | | | | | | 100 | 258 | | 258 |
| 1 | GET W13 CABLE | | | OMH-LA-0B | 1 | | | | 12 | |
| 2 | RMV DUST CAPS FROM CABLE CONNECTORS AND J1 ON FRONT PANEL | | | OTF-CF-RA | 3 | | | | 36 | |
| 3 | CONNECT EITHER END OF W13 TO J1 ON FRONT PANEL OF SST | | | ETF-CE-IA | 2 | | | | 58 | |
| 4 | SUPPORT W13 CABLE (EQ.TO) | | | 00H-0B-D7 | 1 | | | | 51 | |
| 5 | SET POWER SWITCH TO ON | | | OAC-CM-01 | 1 | | | | 4 | |
| 6 | ALLOW 15 SECONDS FOR SST TO CYCLE AFTER POWER IS ON | | | OEL-0D-01 | 42 | | | | 42 | |
| 7 | CHECK EXT PWR ON INDICATOR FOR ILLUMINATION | | | OIT-EV-ZA | 1 | 1 | 50 | | 5 | 3 |
| 8 | CHECK DIGITAL DISPLAY: BLANK IF USING BATTERY POWER; ILLUMINATED AND INDICATES IF WHEN USING AC POWER. | | | OIT-EV-ZA | 1 | | | | 5 | |
| 9 | MOMENTARILY PRESS START/CONT SWITCH; VERIFY PASS/FAIL INDICATOR SHOWS WHITE THEN RETURNS TO BLACK | | | OAC-CM-04 | 1 | | | | 47 | |
| E | ADAPTER/CABLE SELF-TEST | | | | | | 100 | 189 | | 189 |
| 1 | SELECT ADAPTER TO BE TESTED | | | OMH-LA-0B | 1 | | | | 12 | |
| 2 | VERIFY PART NUMBER OF ADAPTER | | | OIT-EV-ZA | | 1 | | | 5 | |
| 3 | VERIFY CABLE W13 IS CONNECTED TO J1 ON FRONT PANEL OF SST | | | OIT-EV-ZA | | 1 | | | 5 | |
| 4 | INSTALL SHORTING CAP ON SELECTED ADAPTER CONNECTOR J2 | | | ETF-CE-IA | 2 | | | | 58 | |
| 5 | CONNECT OPEN END OF CABLE W13 TO J1 OF ADAPTER | | | ETF-CE-IA | 1 | | | | 58 | |
| 6 | HOLD CABLE TEST SWITCH ON | | 7,8,9 | OAC-CM-04 | 1 | | 50 | | 47 | 24 |
| 7 | MOMENTARILY PRESS START/CONT | | 6 | OAC-CM-01 | 1 | | 50 | | -3 | -1 |
| 8 | VERIFY PASS/FAIL INDICATOR SHOWS WHITE AND THEN RETURNS TO BLACK | | 6,7 | OIT-EV-ZA | | 1 | 50 | | -4 | -2 |
| 9 | VERIFY DISPLAYED CODE CORRECT FOR SELECTED ADAPTER | | 6,11 | OIT-EV-ZA | | 1 | | | -4 | |
| 10 | RELEASE CABLE TEST SWITCH | | | OAC-CM-01 | 1 | | 50 | | 4 | 2 |
| 11 | WHEN USING INTERNAL BATTERY, HOLD READOUT RECALL AND NOTE | | 9 | OAC-CM-04 | 1 | | 50 | | 47 | 24 |

A53

TASK CODE: 81ALCMST01

PART NAME: MISSILE SAFE STATE TEST

STANDARD DATA APPLICATION

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | ELAPSED DHU | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 12 | DISPLAY INDICATOR<br>RELEASE READOUT RECALL-EXT ON SWITCH | | | OAC-CM-01 | 1 | | 50 | 4 | 2 |
| F | SAFE STATE TEST | | | | | | | | |
| 1 | RMV SHORTING CAP FROM ADAPTER | | | ETF-CE-RA | 1 | | 100 | 897 | 897 |
| 2 | CONNECT ADAPTER TO CONNECTOR CABLE INTERFACE FOR CHOSEN MISSILE COMPONENT | | | ETF-CE-IB | 1 | | | 47 | |
| 3 | MOMENTARILY PRESS START/CONT SWITCH: VERIFY PASS/FAIL INDICATOR SHOWS WHITE THEN RE-TURNS TO BLACK (USING AC EXT PWR)<br>NOTE: IF SYSTEM IS OK GO TO STEP 13 AND TERMINATE TEST | | | OAC-CM-04 | 1 | | | 68 | |
| 4 | ACTUATE AND HOLD READOUT RECALL/EXT ON SWITCH TO READOUT RECALL (WHEN USING INTERNAL BATTERY POWER) | | | OAC-CM-04 | 1 | | 50 | 47 | 24 |
| 5 | RECORD FAILURE CODE DISPLAYED IF FAILURE CODE IS DESIRED | | | OWR-NT-01 | 1 | | | 8 | |
| 6 | SET AUTO/MANUAL SWITCH TO MANUAL | | | OAC-CM-01 | 1 | | | 4 | |
| 7 | PRESS AND RELEASE START/CONTROL SWITCH TWICE | | | OAC-CM-01 | 2 | | | 8 | |
| 8 | VERIFY DISPLAY SHOWS 00 (ZERO ZERO) | | | OIT-EV-0A | 1 | | | 12 | |
| 9 | MOMENTARILY PRESS AND RELEASE START/CONT SWITCH | | | OAC-CM-01 | 1 | | | 4 | |
| 10 | RECORD ANY FAILURE CODE DISPLAYED | | | OWR-NT-01 | 1 | | | 8 | |
| 11 | REPEAT STEPS 9 AND 10 UNTIL FAILURE CODE DISPLAYED IN STEP 5 IS REPEATED | | | OEL-RS-01 | 120 | 120 | 500 | 120 | 600 |
| 12 | RELEASE READOUT RECALL/EXT ON SWITCH (WHEN USING INTERNAL BATTERY POWER) | | | OAC-CM-01 | 1 | | 50 | 4 | 2 |
| 13 | SET AUTO/MANUAL SWITCH TO AUTO | | | OAC-CM-01 | 1 | | | 4 | |
| 14 | DISCONNECT ADAPTER FROM MISSILE CABLE CONNECTOR | | | ETF-CE-RB | 1 | | | 57 | |
| 15 | SET POWER SWITCH TO OFF | | | OAC-CM-01 | 1 | | | 4 | |

STANDARD DATA APPLICATION

TASK CODE: 81ALCMST01
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PART NAME: MISSILE SAFE STATE TEST

| STEP | DESCRIPTION | WORKER I/D | SIMO WITH | CODE | QTY 1ST | ADD | OCC | DHU ELAPSED | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| G | TERMINATE TEST | | | | | | | | |
| 1 | DISCONNECT POWER CABLE W21 | | | ETF-CE-RA | 2 | | 100 | 425 | 425 |
| 2 | INSTALL DUST CAPS | | | OIF-CF-IA | 2 | | 50 | 94 | 47 |
| 3 | DISCONNECT ADAPTER AND W13 CABLE | | | OTF-CF-IA | 5 | | 50 | 28 | 14 |
| 4 | INSTALL DUST CAPS ON SST TERMINALS (J1&J2), CABLE W13(2) AND ADAPTER (1) | | | OTF-CF-IA | 5 | | | 70 | |
| 5 | INSTALL SHORTING CAP ON ADAPTER | | | ETF-CE-IA | 1 | | | 58 | |
| 6 | COIL CABLES | | | OJP-CC-04 | 2 | | | 36 | |
| 7 | STOW CABLES IN TESTER COVER | | | OMH-LA-0C | 2 | | | 38 | |
| 8 | PLACE TESTER COVER ON TESTER | | | OMH-LA-0B | 1 | | | 12 | |
| 9 | LATCH COVER | | | ONF-LP-01 | 1 | | | 17 | |
| 10 | ASIDE TESTER | | | OMH-LA-0B | 1 | 3 | | 12 | |
| 11 | ASIDE W13 CABLE SUPPORT (EQ.TO) | | | OOH-0B-D7 | 1 | | | 51 | |

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